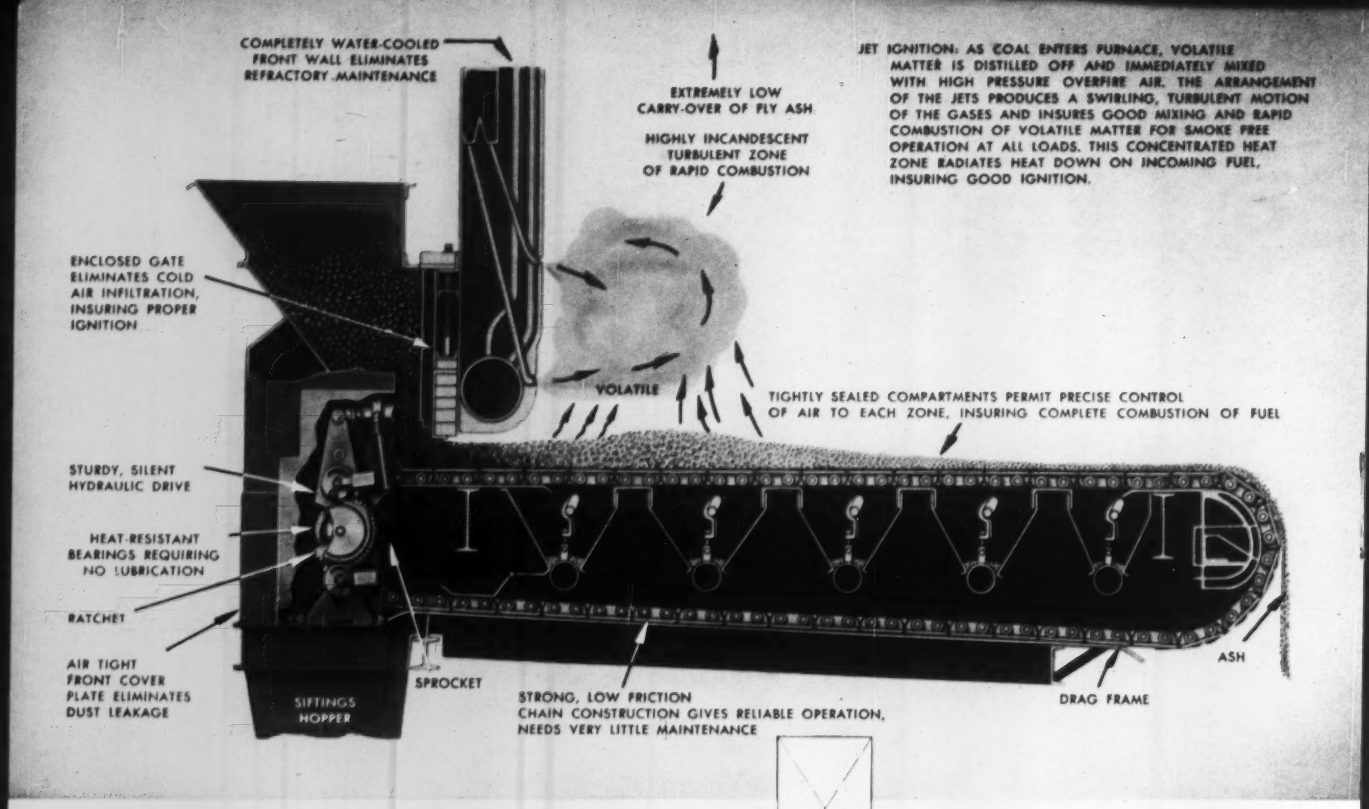
MECHANICAL ENGINEERING

July 1957

in this issue


COMPLETELY WATER-COOLED FRONT WALL ELIMINATES REFRACTORY MAINTENANCE
EXTREMELY LOW CARRY-OVER OF FLY ASH
HIGHLY INCANDESCENT TURBULENT ZONE OF RAPID COMBUSTION
JET IGNITION: AS COAL ENTERS FURNACE, VOLATILE MATTER IS DISTILLED OFF AND IMMEDIATELY MIXED WITH HIGH PRESSURE OVERFIRE AIR. THE ARRANGEMENT OF THE JETS PRODUCES A SWIRLING, TURBULENT MOTION OF THE GASES AND INSURES GOOD MIXING AND RAPID COMBUSTION OF VOLATILE MATTER FOR SMOKE FREE OPERATION AT ALL LOADS. THIS CONCENTRATED HEAT ZONE RADIATES HEAT DOWN ON INCOMING FUEL, INSURING GOOD IGNITION.
ENCLOSED GATE ELIMINATES COLD AIR INFILTRATION, INSURING PROPER IGNITION
VOLATILE
TIGHTLY SEALED COMPARTMENTS PERMIT PRECISE CONTROL OF AIR TO EACH ZONE, INSURING COMPLETE COMBUSTION OF FUEL
STURDY, SILENT HYDRAULIC DRIVE
HEAT-RESISTANT BEARINGS REQUIRING NO LUBRICATION
RATCHET
AIR TIGHT FRONT COVER PLATE ELIMINATES DUST LEAKAGE
SIFTINGS HOPPER
SPROCKET
STRONG, LOW FRICTION CHAIN CONSTRUCTION GIVES RELIABLE OPERATION, NEEDS VERY LITTLE MAINTENANCE
DRAG FRAME
ASH

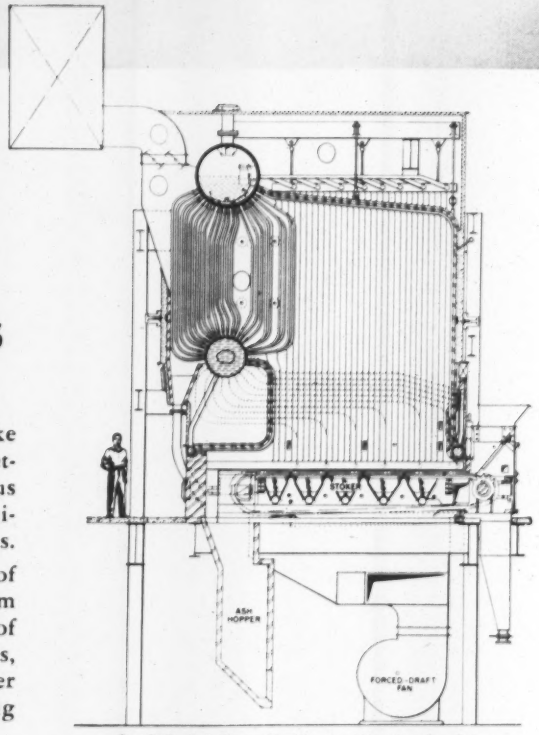
Latest Unit at University of Rochester Will Burn High-Caking Coals

B&W JET-IGNITION STOKER SELECTED TO SOLVE SMOKE AND FLY ASH PROBLEMS

Stable, efficient combustion over wide load ranges, without smoke and with extremely low fly ash, is achieved by the new B&W Jet-Ignition Stoker when burning bituminous and sub-bituminous coals—including high-caking and coking grades. The Jet-Ignition Stoker maintains a clean stack without using dust collectors.

Selection of a B&W Jet-Ignition Stoker for the University of Rochester was made to solve a community relations problem caused by smoke and fly ash. Dr. Lewis D. Conta, Chairman of the University's Division of Engineering, and George D. Haas, Chief Engineer, recommended installation of the unit after observing a commercial installation burning the high-caking coals used by the University.

B&W Jet-Ignition Stokers are another of the developments of B&W engineering and research, supported by nearly a century of experience in all phases of steam generation. If your problem is one of excessive smoking and fly ash emission, Bulletin G-85 will tell you how a B&W Jet-Ignition Stoker can help you. And for any problem in steam generation, B&W engineers are ready to help you and your engineers find the solution. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.



B&W Stirling Boiler with Jet-Ignition Stoker at University of Rochester, designed for 100,000 lb of steam per hr at 125 psi.

G-831-1B

BABCOCK & WILCOX

BOILER DIVISION

FACTS

about

NEW DEPARTURE BALL BEARINGS

NOW A

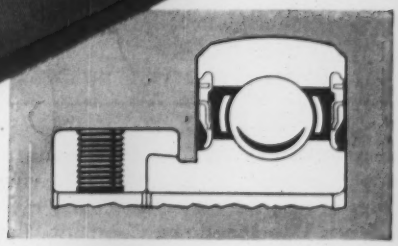
NEW DEPARTURE IN PILLOW BLOCKS

- Clean, rigid, compact design.
- Free of any lubricating fixtures.
- New Departure ball bearings sealed and lubricated-for-life.
- Pillow Blocks easily mounted without special tools.
- Only high capacity precision ball bearings used.
- Accommodates any misalignment.
- 31 shaft sizes, ½" through 2 7/16".
- Interchangeable with most makes.

Send for Catalog PBC for complete details.

GREASE SEALED IN
DIRT SEALED OUT
with
FAMOUS SENTRI-SEAL

ON GUARD
AGAINST DIRT



The bearings are easily applied to the shafting and are positively locked in position with an eccentric cam locking collar and set screw.

New Departure Pillow Blocks employ the performance-proved New Departure Type AE Adapter ball bearings with spherical O.D. for alignability and steel-reinforced Sentri-Seals for long life protection against dirt or grease leakage.

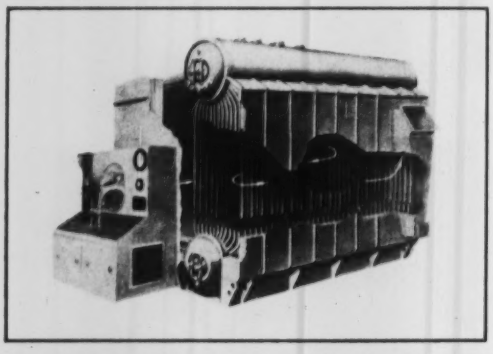
BALL BEARINGS MAKE GOOD PRODUCTS BETTER

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONN.

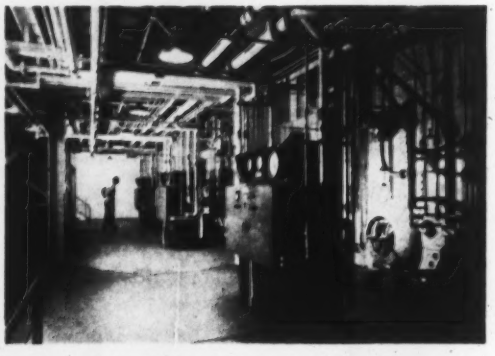
MECHANICAL ENGINEERING, July, 1957, Vol. 79, No. 7. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York, N. Y. Price to members $3.50 annually, single copy 50¢, to nonmembers $7.00 annually, single copy 75¢. Add $1.50 postage to all countries outside the United States, Canada, and the Pan-American Union. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.

Architect's rendering of the Lake Meadows project. Skidmore, Owings and Merrill, Architects.

Chicago's newest planned community is served by C-E Boilers



Cutaway view of typical VP Boiler. For capacities from 4,000 to 40,000 lb of steam per hr. Pressures to 500 psi. Oil or gas fuel.



Firing aisle of the Lake Meadows boiler room showing three of the five C-E Package Boilers, Type VP.

Located on a 100 acre site overlooking Lake Michigan, Chicago's newest planned community, the Lake Meadows project, offers gracious living within the confines of a large city. Owned and managed by the New York Life Insurance Company, Lake Meadows provides distinctively appointed apartments, spacious grounds, a modern shopping center, ample parking facilities, yet is within minutes of the heart of the city. When completed, this project will house 2000 families and will include an eight acre park. Construction has already begun on a new elementary school located on two acres adjacent to the housing development.

A project of this size requires considerable steam capacity to provide ample heat and hot water as well as to perform the many other services required. To do the job, the New York Life Insurance Company originally selected three C-E Package Boilers, Type VP. Later, as new housing units were added, two additional VP Boilers were installed. Their outstanding performance and efficient, trouble-free operation is evidenced by the repeat order placed with Combustion for the final two units.

Complete information on C-E Package Boilers is available in Catalog VP-3. Write for your copy.

COMBUSTION ENGINEERING

Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

Canada: Combustion Engineering-Superheater Ltd.

B-986A

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS, PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

COMPLETE LINES OF WALWORTH VALVES for POWER PLANT SERVICE

Featuring Walworth Pressure-Seal Valves

Here are cast steel valves built for high-pressure, high-temperature service. The unique bonnet-to-body design utilizes internal line pressure for a tight, leakproof connection. The higher the pressure the tighter the bonnet joint! Bulky, heavy bonnet flanges, bonnet studs, and nuts are completely eliminated providing a modern valve design of truly streamlined proportions. Maintenance is simplified as Walworth Pressure-Seal Valves are easily assembled, disassembled, and insulated.

Walworth Pressure-Seal Valves are available in Series 600, 900, 1500, 2500, and in a wide range of sizes and types. Complete information is available from your nearby Walworth Distributor—or—write Walworth for for a free copy of Circular 16.

and including these valves for "'round-the-plant" use!

WALWORTH SMALL CAST STEEL Y-GLOBE VALVES. Simplified design eliminates many of the problems encountered in high-temperature, high-pressure service. No bonnet joint. Improved back-seat design means longer life for packing rings.

WALWORTH LUBRICATED PLUG VALUES. Easy turning—quick operating. Lubricant can be renewed while the valve is in service. Lubricant completely surrounds the plug ports for a tight seal against leaks. Remember, always use Walworth Lubricant in Walworth Lubricated Plug Valves.

WALWORTH BRONZE VALVES. Standardized lines of bronze valves provide an unsurpassed system of interchangeability of parts, drastically reducing inventory problems. Walseal Valves with brazing ends also available in a variety of types.

WALWORTH IRON BODY GATE VALVES. Straight-flow port design reduces fluid turbulence to a practical minimum. Seat rings of end-seated type are screwed into the body. Brass liner on glands assures greater resistance to corrosion and scoring. Available with threaded or flanged ends.

WALWORTH CAST STEEL GATE VALVES. Bolted bonnet, wedge gate, OS&Y. Bonnets and bodies are engineered to withstand pressure and minimize distortion. Heavy steel walls provide extra strength and longer life. Deep stuffing boxes in all sizes (2" to 24") insure tightness and maximum packing life. Also available in globe and angle types.

WALWORTH also offers Plastic Valves, Fittings, and Pipe of polyvinyl chloride, moulded to Walworth's specifications by General American Transportation Company of B. F. Goodrich Chemical Company Geon!

WALWORTH

Manufacturers since 1842

valves . . . pipe fittings . . . pipe wrenches

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Walworth Company of Canada, Ltd., Toronto

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IMPROVED BLOWER NOZZLE and

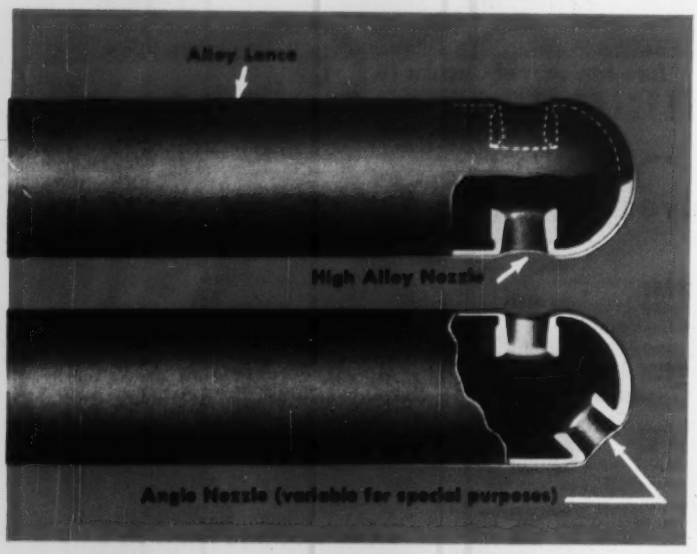
more important features of the

New Diamond Series 300 IK
LONG RETRACTING BLOWER

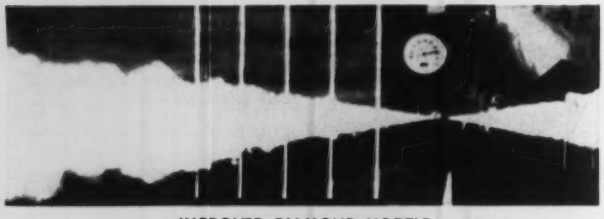
This improved nozzle provides more available cleaning energy per pound of steam or compressed air. A modified venturi, it is the result of extensive research during which more than 50 contours were tested.

The positively-controlled, close helical cleaning pattern assures optimum coverage of the heating surface. Return travel path is exactly intermediate to forward travel path . . . resulting in a positive nozzle sweep every inch.

These features are two of many reasons why the Diamond Series 300 IK Blower does a better and more economical job of cleaning surfaces which require a long retracting blower. Other advantages are listed at the bottom of the opposite page. Ask the nearest Diamond office for Bulletin 2111AA which will tell you much more about the new Series 300 IK.

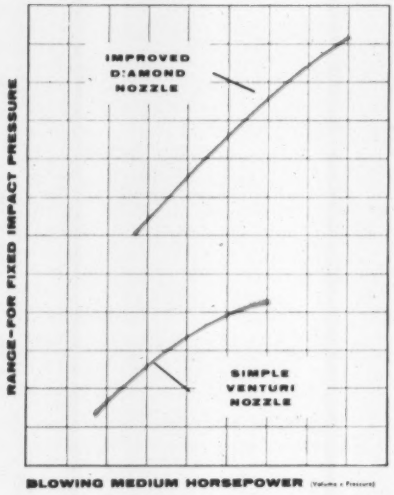


Improved Diamond Type "A" Nozzle has low approach velocity for optimum nozzle performance (see curves below). It provides greatest impact for any given blowing pressure . . . means greater effectiveness and economy.



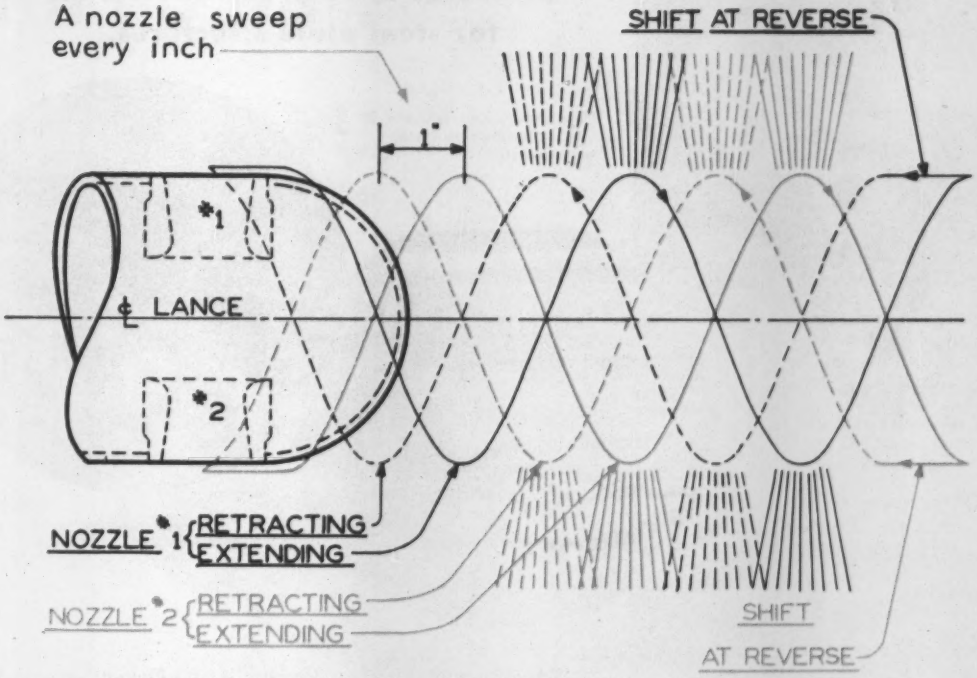
IMPROVED DIAMOND NOZZLE

7818 SIMPLE VENTURI NOZZLE

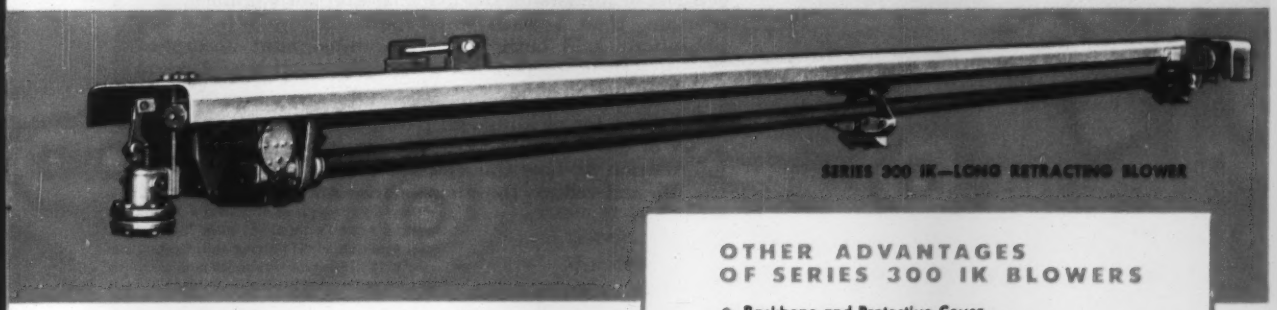


Note the greater blowing range of the improved Diamond Nozzle when compared with a simple venturi nozzle under identical test conditions.

IMPROVED CLEANING PATTERN



Nozzle-sweep-every-inch blowing pattern assures COMPLETE coverage of ALL surface EVERY time



OTHER ADVANTAGES OF SERIES 300 IK BLOWERS

- Backbone and Protective Cover
- Front End Single-Motor Drive
- Compact, Accessible Electric Power and Control Terminal Facilities
- Positive Gear Carriage Drive
- Poppet Valve with Adjustable Pressure Control
- Positive Mechanically Operated Valve
- Single Point Outboard Suspension
- Oversize Lance (Step-Tapered for Extra Long Travel)
- Auxiliary Carriages for Extra Long Travel
- Designed for Quick, Easy Servicing

No other blower gives you all these advantages.

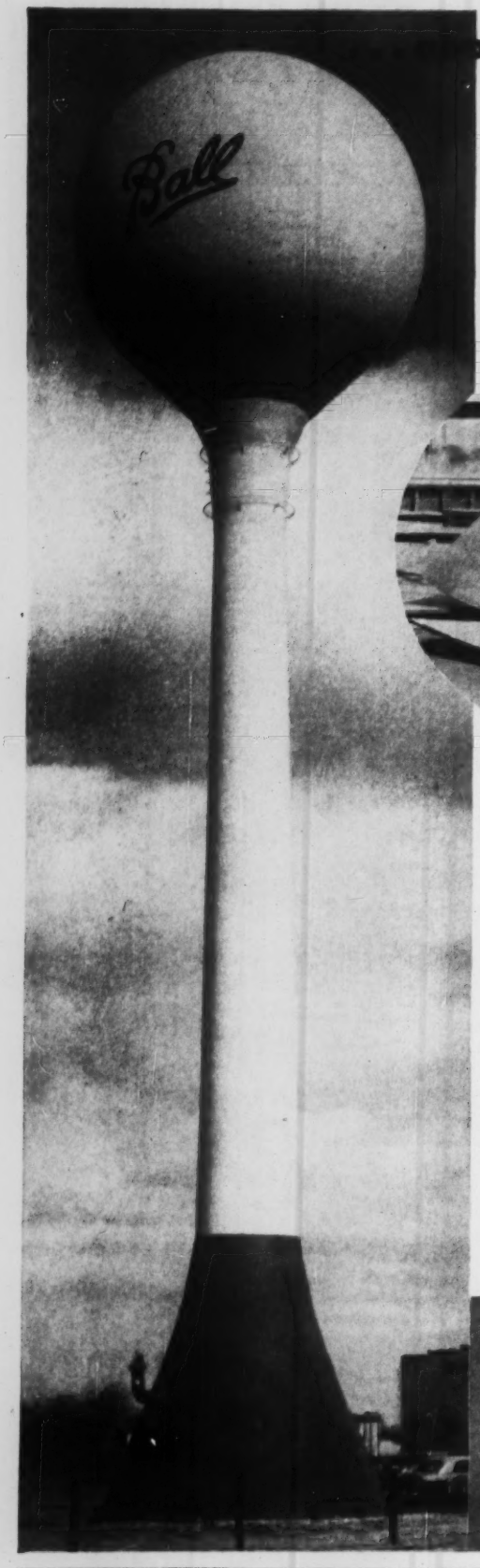
Diamond

DIAMOND POWER SPECIALTY CORPORATION

LANCASTER, OHIO

Diamond Specialty Limited

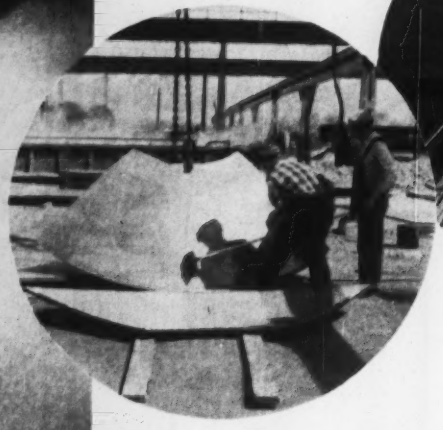
Windsor, Ontario

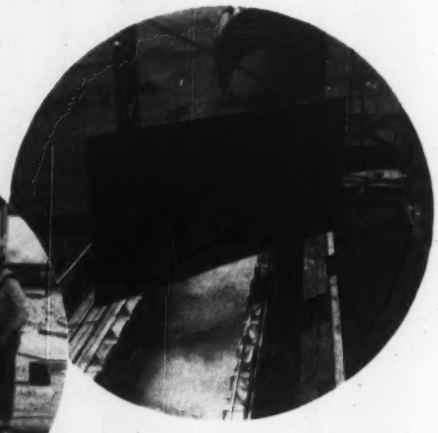


...out Weather and WATERSPHERES

How CB&I pickling process promotes beauty and protection for steel plate structures.

Plate coming from sulphuric acid bath where mill scale was removed. ▶





◀ Plates receive special prime coat while steel is still warm.

The Horton® Pickling Process is an efficient, economical means of removing mill scale from steel. It serves to eliminate the "human element" in the process of cleaning steel prior to painting and provides a clean dry surface, with an iron phosphate coating, which improves the bond between paint and steel.

A thorough manufacturing-type operation, the process consists of immersing the material in a hot sulphuric acid solution, then a wash water bath—followed by a hot phosphoric acid bath. Special priming paint is applied immediately after pickling . . . while metal is still warm to insure better bond.

Facilities for pickling and painting are now maintained at all of our four, strategically located plants. Write for information on how this efficient service can help extend the life and reduce the maintenance on *your* next CB&I structure.

◀ This 100,000-gal. Horton Watersphere® was pickled and painted before shipment to Ball Bros., Hillsboro, Illinois, nationally known manufacturer of glass jars.

CB&I

Chicago Bridge & Iron Company

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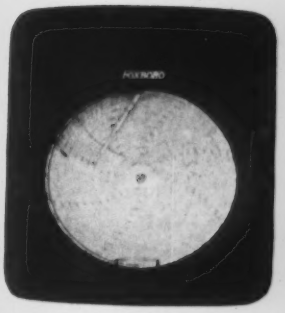
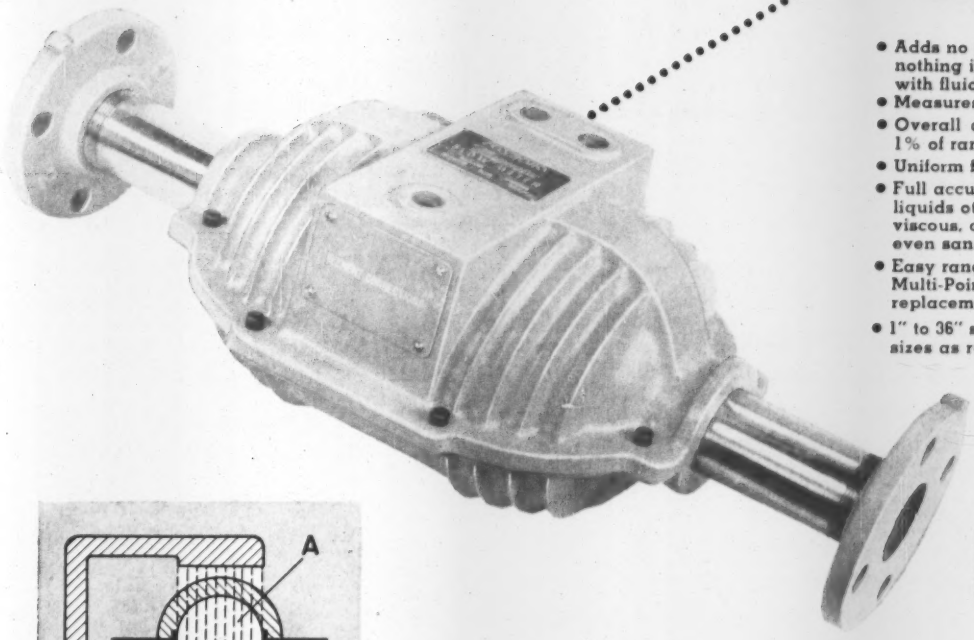
New Orleans • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • South Pasadena • Tulsa
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.

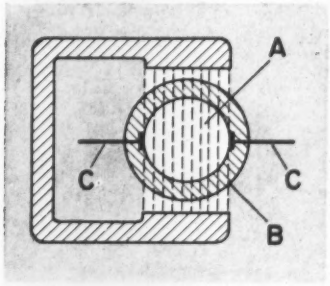
NOW! a flow meter with no flow restrictions!





- Adds no pressure drop — nothing inside pipe to interfere with fluid flow.
- Measures fluid velocity directly.
- Overall accuracy better than 1% of range over entire scale.
- Uniform flow scale.
- Full accuracy sustained even on liquids other meters can't handle: viscous, corrosive, or pulpy — even sand-water slurries.
- Easy range change — either by Multi-Point Switch or range coil replacement, as preferred.
- 1" to 36" sizes standard — larger sizes as required.

FOXBORO MAGNETIC FLOW METER



SIMPLE, TROUBLEFREE, OPERATION

The Foxboro Magnetic Flow Meter operates on the same principle as a power generator. A magnetic field (A) is maintained through a standard pipe section (B) of stainless steel or other non-magnetic material. This pipe section is lined with Kel-F® or other insulating material. Liquid passing through pipe acts as moving conductor, generating an electric voltage which varies in proportion to liquid's average velocity. Flush electrodes (C) in pipe wall "pick up" this voltage which is recorded in desired flow units by Dynalog Electronic Recorder or Controller.

This premium-performance meter measures *magnetically* the flow rate of virtually any liquid except hydrocarbons. It completely ignores such common metering headaches as turbulence, suspended solids, and variations in conductivity, density, and viscosity. It even measures reversing flows.

Installation is simple. The magnetic spool piece connects into the line like any equivalent length of pipe — no seals, purges, meter runs, or straightening vanes required. Connects by 2-conductor cable to remote Dynalog Electronic Flow Recorder.

Maintenance is practically eliminated. There are no pressure taps to become plugged or frozen, no working parts to foul.

Foxboro Magnetic Flow Meters are already in use on such widely different liquids as beer, sand-and-water, rosin size, rock-and-acid slurry, viscose, and highly corrosive liquid detergent. Find out how this precise, troublefree flow meter can help *your* processing. Write for Bulletin 20-14A.

THE FOXBORO COMPANY, 967 NEPONSET AVENUE, FOXBORO, MASS., U. S. A.

FOXBORO
REG U S PAT OFF

Foremost in FLOW METERING

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

Now Under Construction...

18% MORE POWER

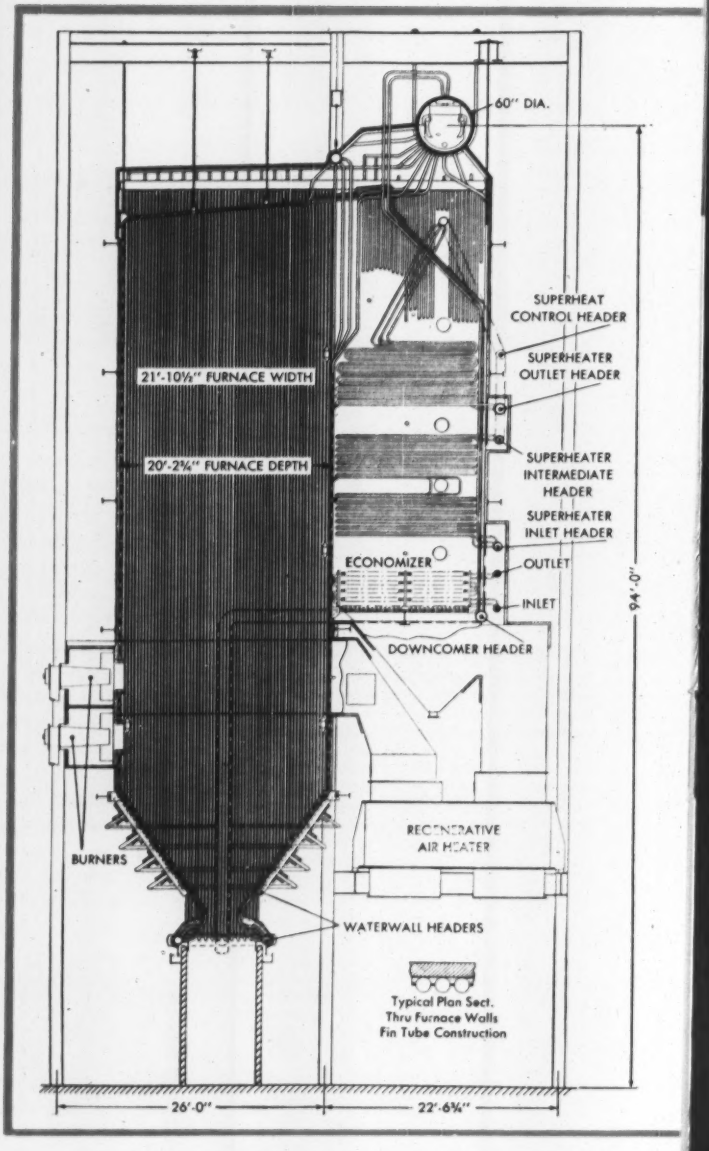
New 88,000-kw Yarmouth Station will be served by

TWO FW STEAM GENERATORS

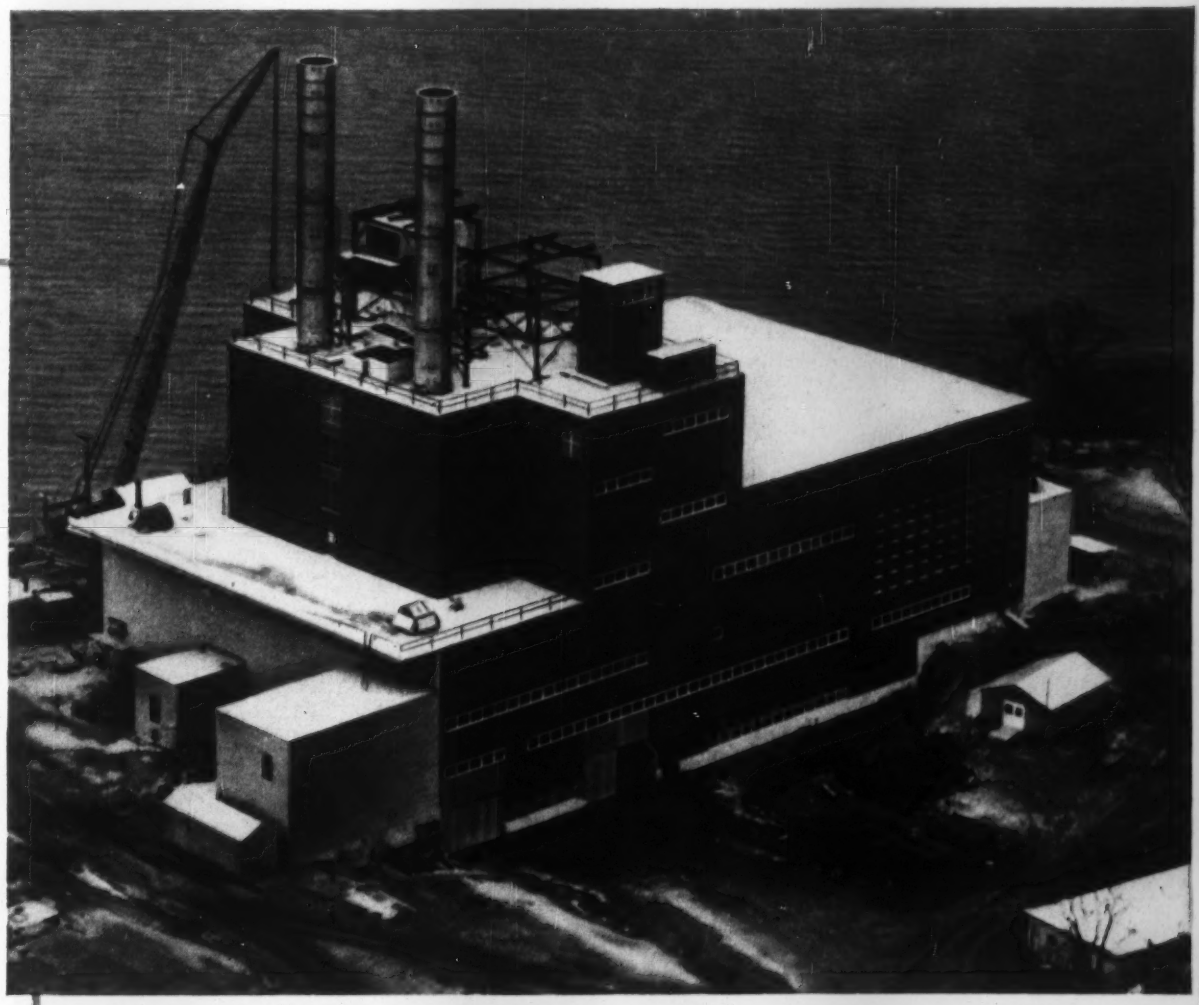
To meet Maine's growing demand for electric power, the Central Maine Power Company is building a new station at Yarmouth which increases total system capacity from 470,730 to 558,730 kw. This installation will consist of two identical units, each with a rated capacity of 44,000 and capability of 50,000 kilowatts.

Foster Wheeler is supplying the two steam generators for this important new station. Each will produce 490,000 pounds of steam per hour at 1575 psig design pressure, 950 F, and will deliver steam to the turbines at 1250 psig. These units are designed for either oil or coal firing.

With more than fifty years of experience in steam generation—and the finest modern manufacturing facilities in three large plants — Foster Wheeler welcomes the opportunity to quote on your requirements. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*



for CENTRAL MAINE



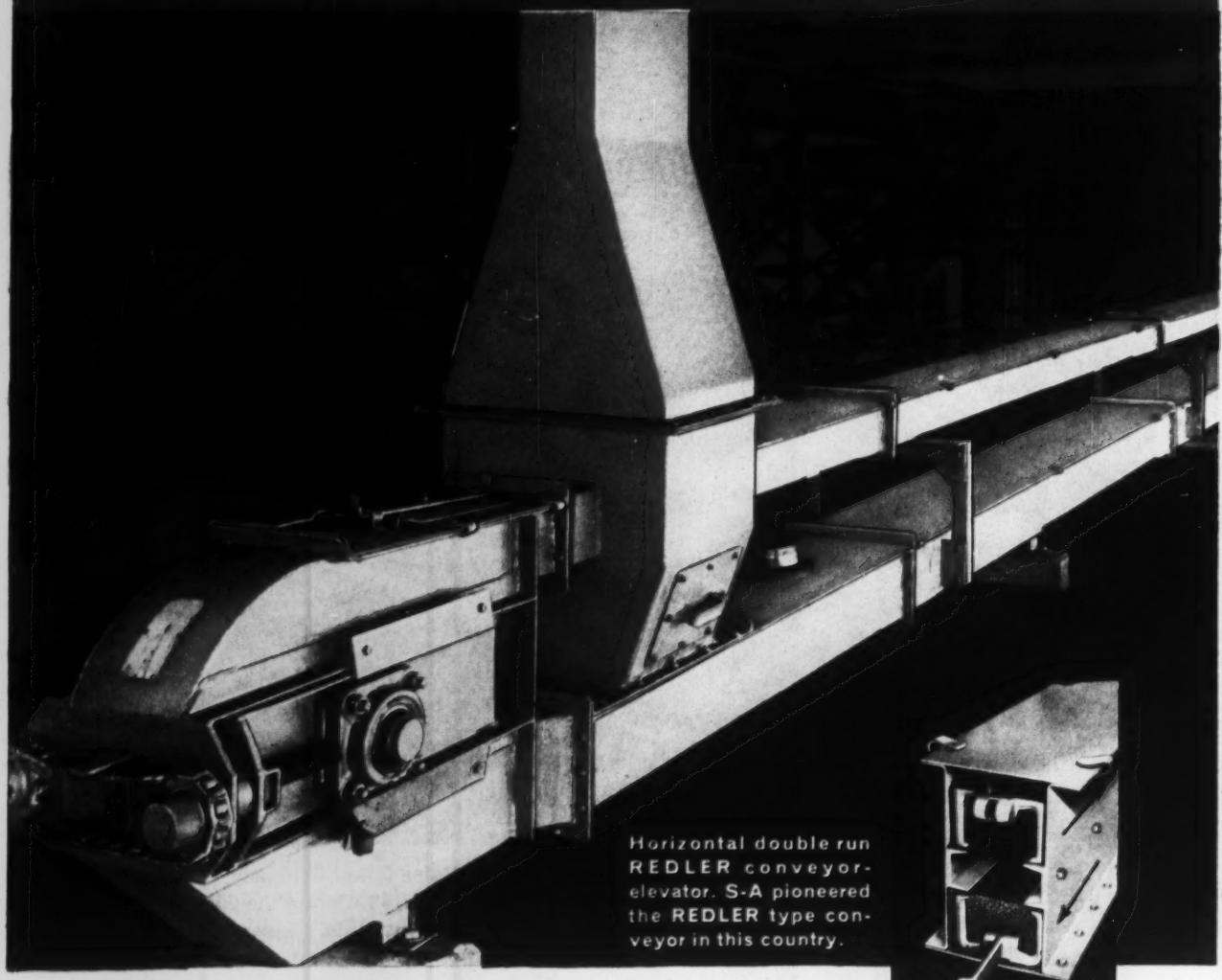
An aerial view of the new Yarmouth Station of Central Maine Power Company. Unit No. 1 is scheduled to be in operation this year and Unit No. 2, in 1958. During the past decade, virtually every kind of Maine business has drastically increased its kilowatt-hour use of electric power. The Yarmouth Station will keep CMP well ahead of this growing demand — immediately increasing total system capacity by 18%.

FOSTER WHEELER

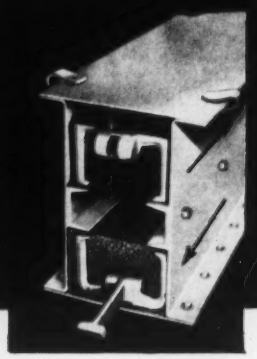
NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

STEPHENS

your Best Buy



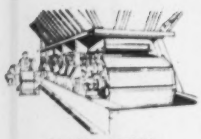
Horizontal double run REDLER conveyor-elevator. S-A pioneered the REDLER type conveyor in this country.



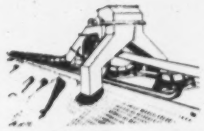
S-A MANUFACTURES A COMPLETE LINE OF PRODUCTS

BELT CONVEYORS

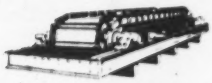
VIBRATING SCREENS



MANGANESE STEEL PAN FEEDERS



BELT CONVEYOR TRIPPERS



PAN CONVEYORS

S-A ADAMSON

in bulk material conveying equipment

The movement of bulk materials is a critical phase of the production process. It can be a costly one unless the most modern, scientific methods and equipment are used.

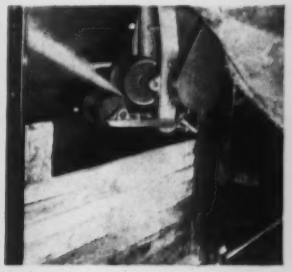
For over fifty years, to the whole wide range of industry, the big name of STEPHENS-ADAMSON has signified the finest engineering know-how in bulk materials handling equipment. Over these years, S-A engineers have been called upon by power producers, chemical processors, wood and paper product manufacturers, food processors, the mining industry the rock products industry, and many other classifications of industry, for solutions to their peculiar problems.

This year, increased demand for your product plus competitive pressure may dictate a long, close look at your bulk material handling methods. This is where an S-A sales engineer can offer solid advice. His background assures you of the very best system for your investment.

Remember the big name of S-A. It's your BEST BUY when experience counts most.

Twin S-A conveyor belts and tripper installation carries refractory clay to storage bins. Belt conveyors are adaptable to a wide variety of bulk products, can deliver big tonnage with low cost and little maintenance.

A double wing stacker built by S-A delivers a high volume of material to either side. It travels on track, can stack to a height of 80 feet. Tripper in housing feeds to either conveyor boom.



Swiveloader trims a boxcar, throwing grain to furthest corners. The S-A line of loaders range from portable pilers and car loaders to huge ship trimmers. They handle a wide variety of products.

Bulletins are available on all S-A conveyor equipment. Write today.

STEPHENS-ADAMSON MFG. CO.

19 RIDGEWAY AVENUE, AURORA, ILLINOIS
LOS ANGELES, CALIFORNIA
BELLEVILLE, ONTARIO

S-A manufactures a wide range of material handling products in three complete plants in U. S. and Canada.

- Belt Conveyors
- Belt, Pan and Plate Feeders
- Ship Loading Boom Conveyors
- Stacking Conveyors
- Storage and Reclaiming Systems
- "Natural Frequency" Vibrating Conveyors
- REDLER Conveyor-Elevators
- ZIPPER Conveyor-Elevators
- Conveyor Belt Cleaners
- Headshaft Holdbacks
- Grizzlies and Screens
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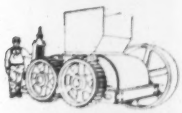

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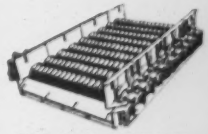
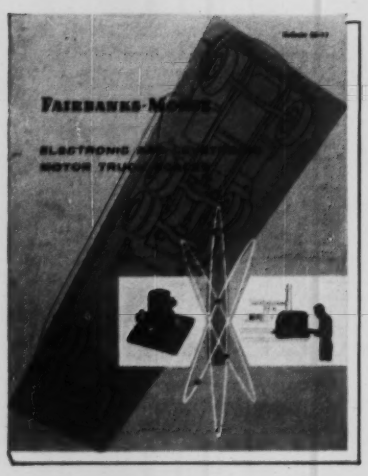
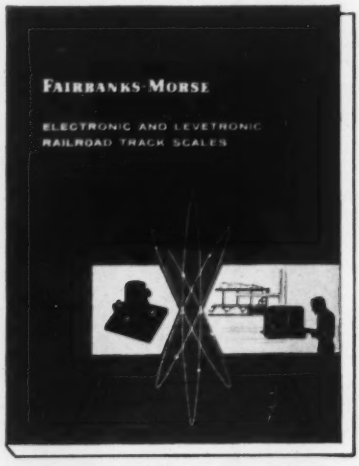


LIVE ROLL GRIZZLIES





The story of Fairbanks-Morse Electronic Scales in seven volumes

Just off the press—seven new bulletins about Fairbanks-Morse electronic weighing and batching machinery. The covers pretty well identify themselves as illustrated above, except that you might not know that EPC is a completely automatic batching system that operates from punch cards . . . or that Batchetron is a slightly less automatic batcher with quick provision for manual preset of the cycle . . . or that CDO is a "read-out" instrument that will translate the weight message of any of the other six into the language "spoken" by automatic typewriters and automatic adding machines and automatic tape punches.

Write today for one or more of the new bulletins on Fairbanks-Morse electronic weighing and batching. Fairbanks, Morse & Co., Scale Division, Dept. ME-7, 600 South Michigan Avenue, Chicago 5, Illinois.

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a name worth remembering when you want the BEST

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The story of plus value in Roller Chain...

written on the end of a pin

To provide the long wear life and fatigue resistance you expect from a roller chain, the pins *must* have two characteristics:

One... a case-hardened surface for longest wear life plus a tough, resilient core for shock load resistance.

Two... comparatively soft ends for secure riveting and maximum holding power in the link plates.

How can you have these two opposites in one pin?

In Rex Roller Chains, the pins are completely copper-plated. Then, the copper is ground off only the pin body, leaving the pin ends plated. Next, they're carburized in controlled-atmosphere gas furnaces. Since copper will not absorb carbon during heat treatment, the pin ends are not hardened... remain relatively soft. The pin body gets the file-hard case depth you need.

Look for the *copper-plated pins* before you buy roller chain. They're visible evidence of the *plus* value in Rex Roller Chains. For the story on the "finest roller chains made," mail the coupon. CHAIN Belt Company, 4765 W. Greenfield Ave., Milwaukee 1, Wis.

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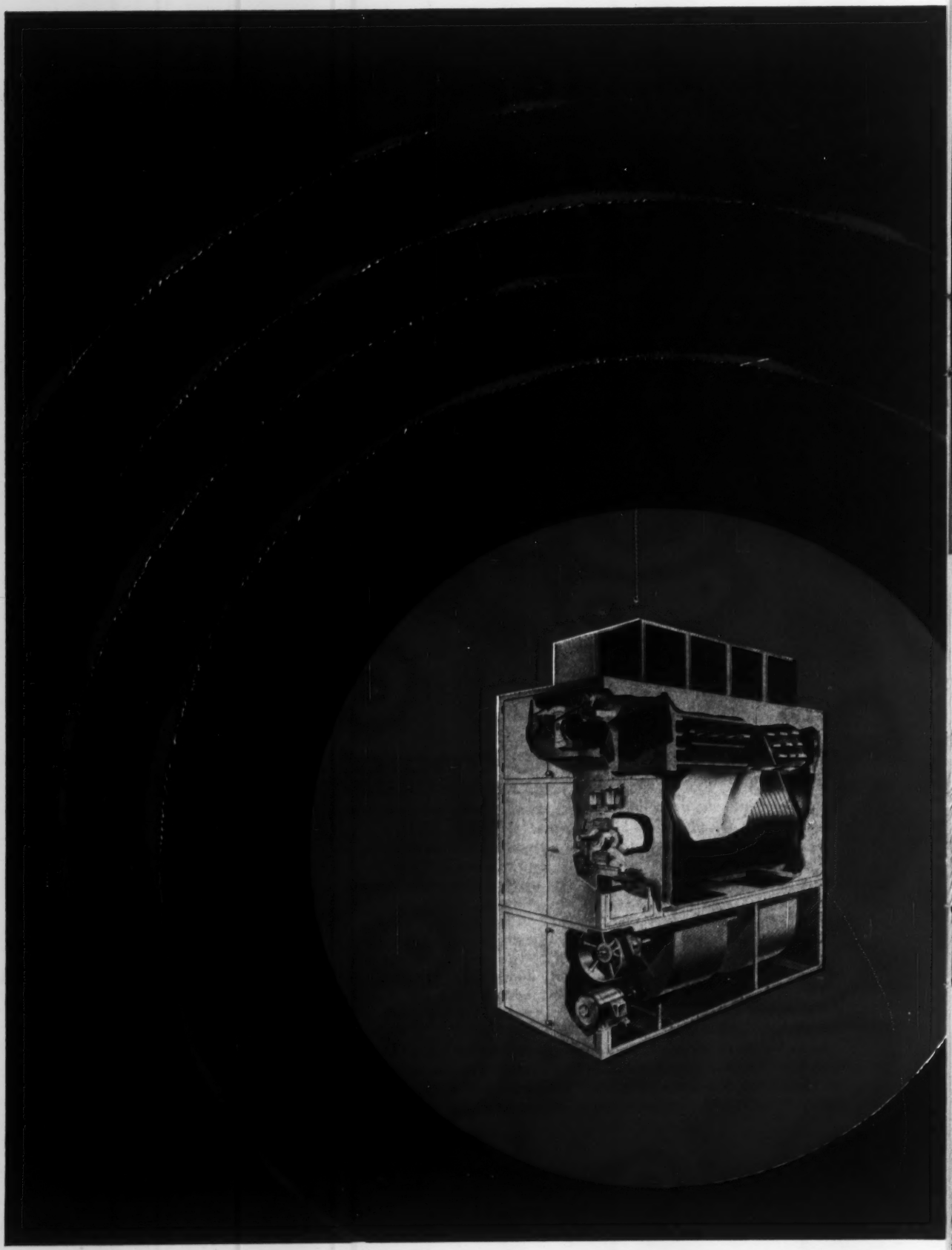

the all-new
Dravo **COUNTERFLO** *heater*
introduces

a new concept in burning fuel

Developed by the most exhaustive research program ever undertaken in the field, the new Dravo *Counterflo* heater introduces an entirely new concept in the burning of fuel. This new concept involves not only many entirely new and exclusive Dravo features, but integrates every part of the heater into a "unitized" design. The functions of the principle elements—burner, combustion chamber, fans and discharge plenum—work in complete harmony, with the result that they extract every possible Btu from the fuel, transmit the heat to the airstream with unmatched efficiency, and distribute the heated air uniformly. Look at these outstanding features of the all-new Dravo *Counterflo:*

- **NEW DISCHARGE PLENUM**—distributes heated air at high velocity without annoying drafts.
- **NEW AIRFOIL COMBUSTION CHAMBER**—stainless steel, ribbed for extra strength and channeling of airflow—guaranteed for 10 years.
- **NEW INDUCED DRAFT FIRING**—automatically controls fuel/combustion air ratio, adds extra safety, extra efficiency.
- **NEW PYROJET BURNER**—exclusively Dravo—first burner developed specifically for direct-fired space heaters. Burns heavy No. 5 oil efficiently. Switches from gas to light oil automatically.
- **NEW LOW-SPEED FANS**—forwardly curved, low-speed, double inlet fans with high efficiency reduce horsepower requirements in the new *Counterflo* drastically.

The new Dravo heater is extremely adaptable. Separate furnace section perfect for use as duct-type furnace, suitable for air conditioning, process drying and air tempering applications. May be mounted in any position to save space. Check with your Dravo representative for full information on this amazingly versatile heater, or write to Dravo Corporation, Pittsburgh 22, Pennsylvania.

Ask for Bulletin 564-47

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Blast furnace blowers • boiler and power plants • bridge sub-structures • cab conditioners • docks and unloaders • dredging • fabricated piping foundations • gantry and floating cranes • gas and oil pumping stations • locks and dams • ore and coal bridges • process equipment • pumphouses and intakes • river sand and gravel • sintering plants • slopes, shafts, tunnels • space heaters • steel grating • towboats, barges, river transportation

"It'll pay us to replace it with an ALDRICH PUMP!"

Downtime, due to pump failure, is always a costly item. It takes the reliability and freedom from maintenance found in an Aldrich Pump to assure 100% availability of hydraulic power.

The very simplicity of the Aldrich Direct Flow design means horizontal straight line flow from suction to discharge. Reduced space between valves results in higher volumetric efficiency. Fluid-end sectionalization for fast, easy maintenance; changeable plunger sizes; and interchangeability of parts are additional reasons why Aldrich Pumps have earned a reputation for dependable, low cost performance on applications such as die casting, hydraulic press operation, roll balancing, descaling and hydraulic testing.

For your tough pumping problems, it pays to specify Aldrich. Write today for a copy of Data Sheet 100, a condensed catalog and selection chart covering our entire line. The Aldrich Pump Company, 29 Pine Street, Allentown, Pa.

Four 5" stroke Aldrich Direct Flow Pumps on die casting service in a midwestern metalworking plant. These pumps are handling 250 gpm at 1500 psi.

THE ALDRICH PUMP COMPANY

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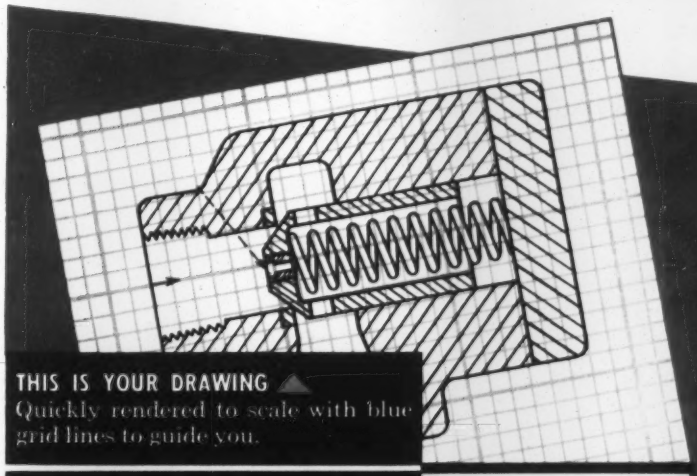

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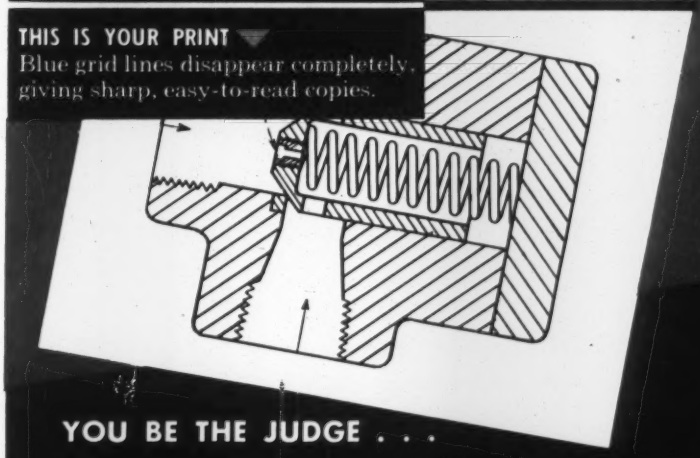

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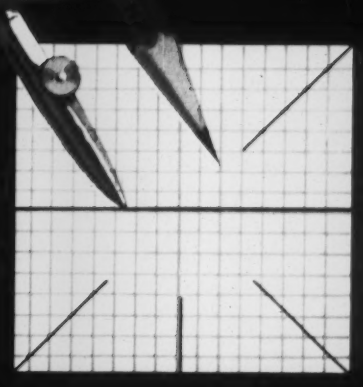

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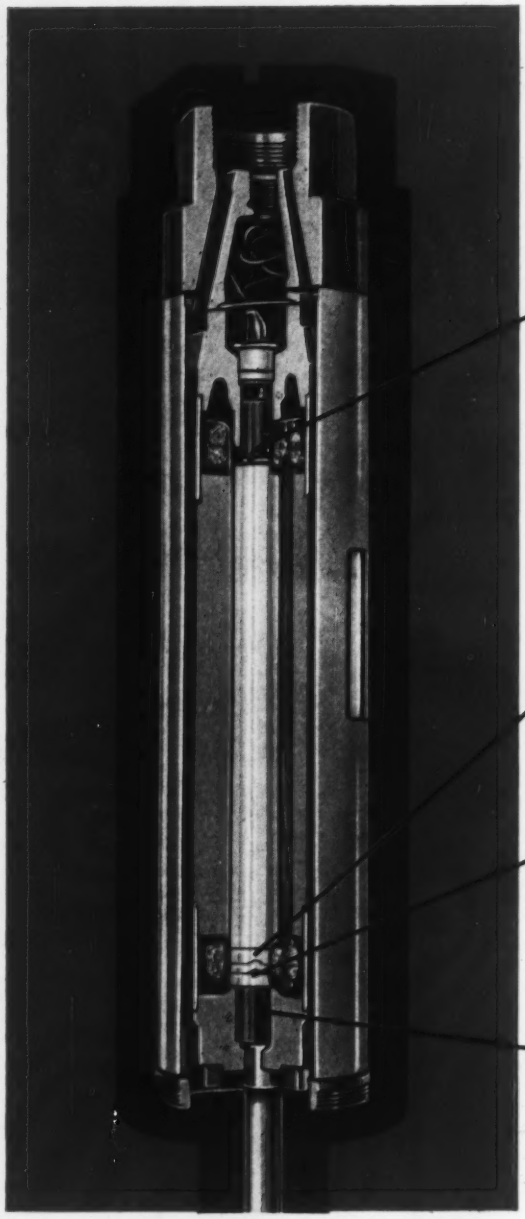
In Leland submersible pump motors

GRAPHITAR® (CARBON-GRAPHITE) and GRAMIX® (PRODUCTS OF POWDER METALLURGY)

operate with gasoline

as the only

lubricant!



Running directly in gasoline, this superbly-designed Leland submersible motor embodies two GRAMIX thrust washers and two GRAPHITAR bearings to keep the operation of this amazing explosion-proof pump motor safe and smooth.

Thirty years ago the manufacturer of these pumps—the Leland Electric Co., Dayton, Ohio, a division of American Machine and Foundry Co., developed the first gasoline curb-pump motor to receive Underwriters' Laboratories' approval. Throughout their long experience, they have selected every component with great care. It is thus significant that for Leland's submersible motor they selected GRAPHITAR and GRAMIX bearings.

GRAPHITAR is a non-metallic, carbon-graphite material that will not weld or score even when in contact with a metal shaft. Any liquid will act as a lubricant, thereby reducing friction and increasing service life. With low-viscosity liquids such as gasoline, friction is at a minimum because of the low film strength.

GRAMIX, tough, long-wearing sintered-metal, has an extremely high particle hardness and excellent surface finish; can be precision die-pressed to tolerances within .0005". GRAMIX parts can withstand incredible amounts of pounding action. These factors, coupled with their extremely low cost, have helped add to the increasing use of GRAMIX parts in many industries.

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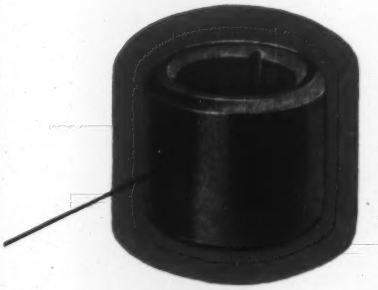
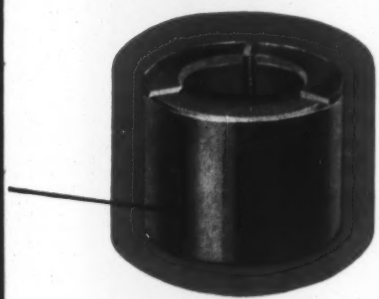


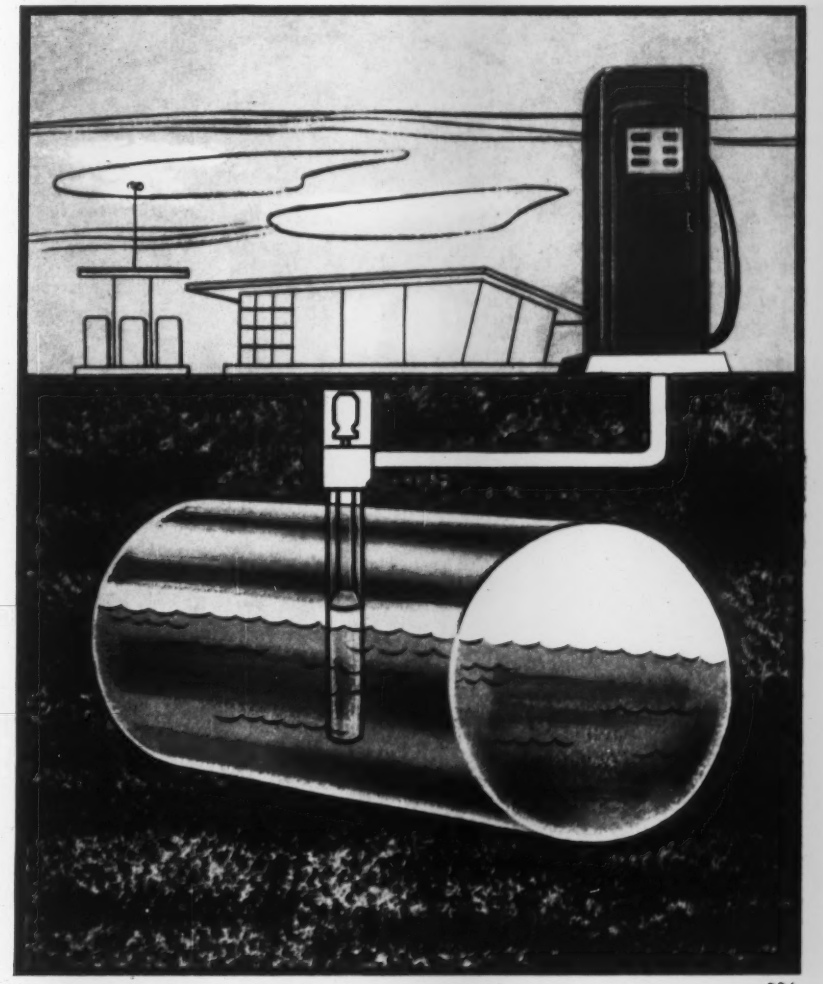
GRAPHITAR
GRADE 14
RADIAL BEARING

GRAMIX STEEL
THRUST BEARING
DRIVE

GRAMIX HARDENED
STEEL THRUST PLATE



GRAPHITAR RADIAL
AND THRUST BEARING



236

Write today for these two new engineering bulletins, GRAPHITAR Bulletin No. 20 and GRAMIX Bulletin No. 21.

GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW 4, MICHIGAN

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Before we cut the cake...

Wm. W. Nugent & Co., Inc., on the occasion of its sixtieth anniversary, wishes to express its sincere appreciation for the confidence and loyalty toward Nugent products, demonstrated by an ever increasing acceptance throughout industry.

For three generations, Nugent products have embodied only highest quality design, materials and workmanship. The future shall find no compromise with that policy.

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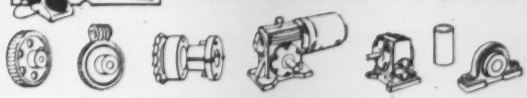
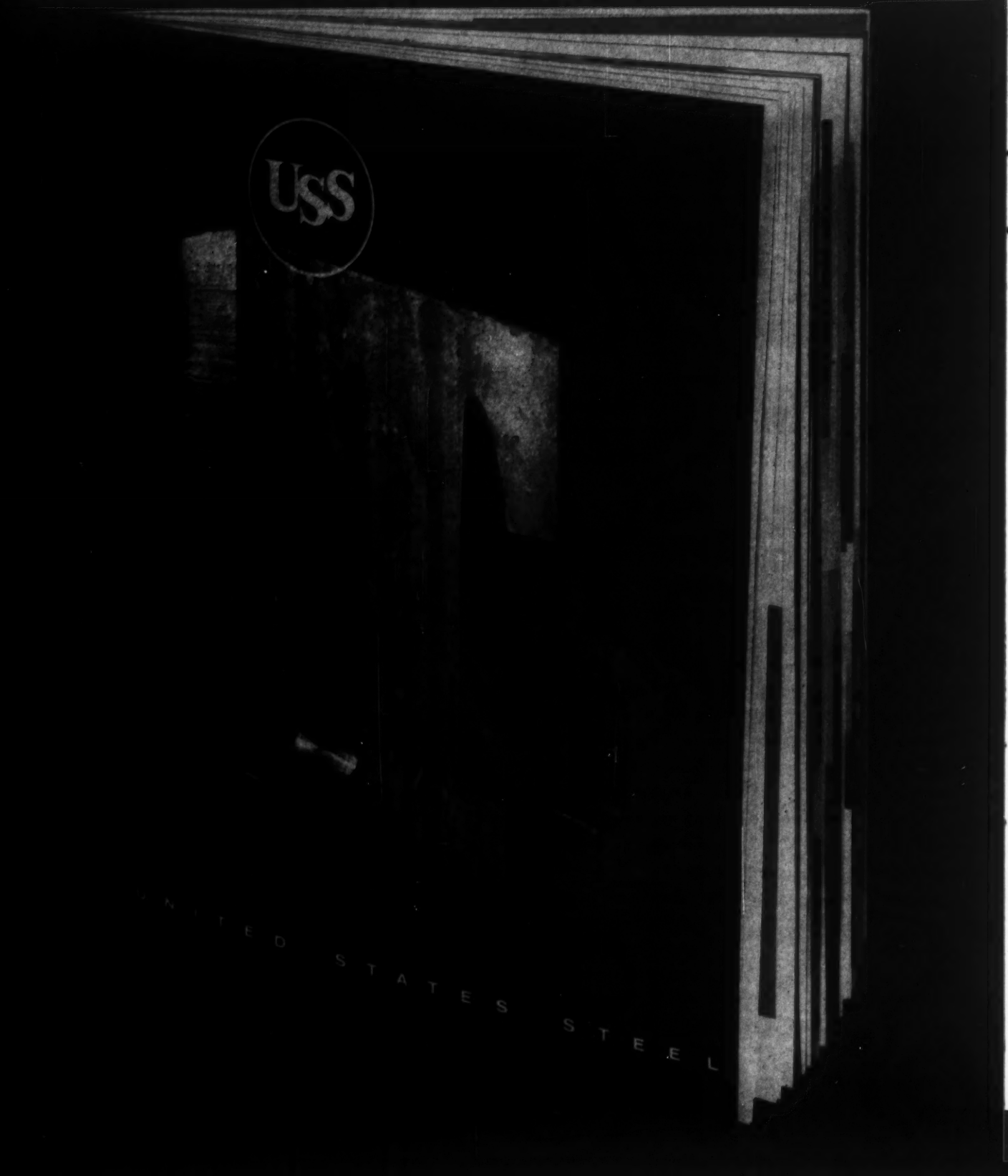


Stock Gears • Sprockets and Chain • Speed Reducers • Bearings • Couplings

New technical booklet contains . .



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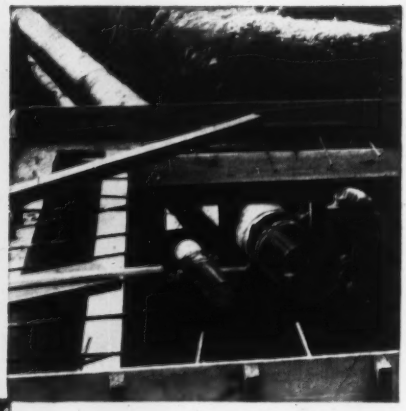
UNITED STATES STEEL

MR. ENGINEER:

LET'S FACE THE FACTS . . .

How can an underground piping system be watertight when you can't *AIR TEST* it?



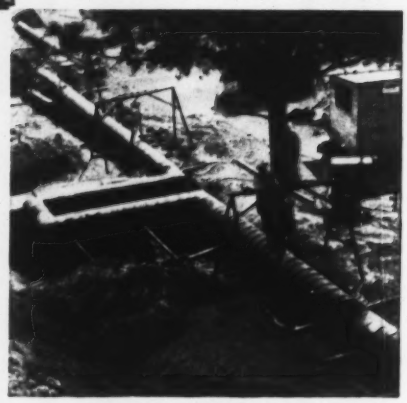
Test caps applied to unit ends for air testing full-welded conduit system.

WITH

RIC-WIL

During air test, conduit field welds are checked with soap solution.

Tested and ready for lowering long lengths.



YOU can AIR TEST your system...

The RIC-WIL method of making full-welded field closures allows the installer to AIR TEST the system prior to completion and backfilling. This simple 15 lb. pressure test gives greater assurance of a tight, leak-proof system. It provides the finest practicable protection to the owner against an initial system failure ...and most important, the long range effects of water corrosion.

Ask a RIC-WIL field representative for detailed information regarding Air Test procedure or write for catalog covering recommended field installation details . . . and remember, it pays to do it RIGHT the first time . . .

Quality Piping Systems . . .
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RIC-WIL PREFABRICATED INSULATED PIPING SYSTEMS

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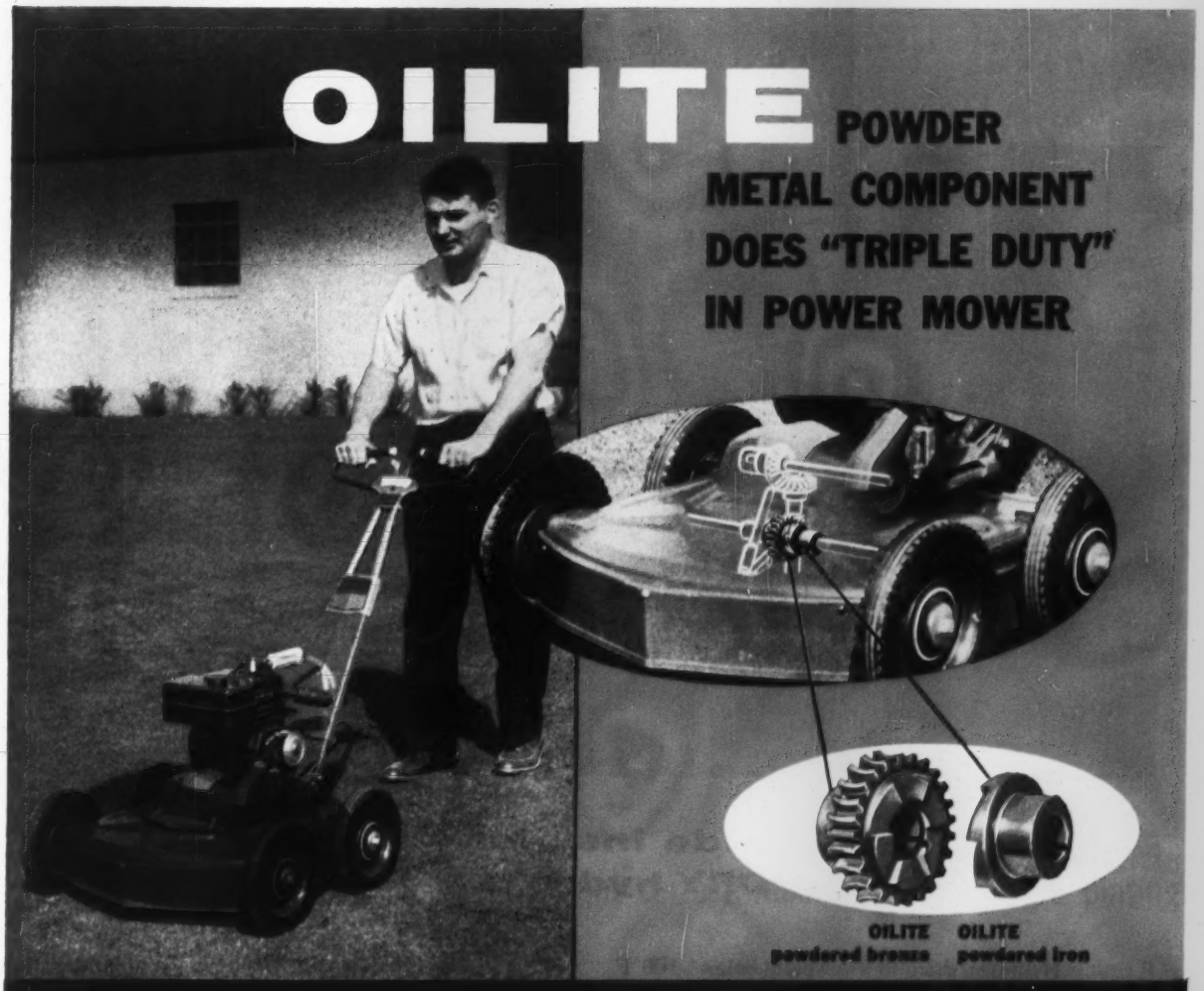
OILITE POWDER METAL COMPONENT DOES "TRIPLE DUTY" IN POWER MOWER



Another cost-saving application of **Amplex Powder Metallurgy**

How to make a self-propelled rotary mower more compact and still permit the rotary blade to operate while the mower idled—*without increasing costs!* That was the problem company engineers tackled. One way was to combine three components—over-running clutch, oil pump piston cam, differential—into one. They experimented widely with designs and materials. Result: an OILITE powdered bronze worm gear with one side of the hub a cam operating the oil pump, the other side a wheel drive ratchet. (The other half of the ratchet—fixed to the drive shaft—OILITE powdered iron.) The design achieved the desired compactness and idling characteristics. OILITE powder metallurgy achieved a *major reduction* in cost, an *increase* in serviceability.

Do you have a design problem? Maybe Amplex has the answer. Write for detailed information about Amplex powder metal components—OILITE Bearings, Parts, Filters. Or call your nearest engineering representative listed in the yellow pages under "Bearings—OILITE."

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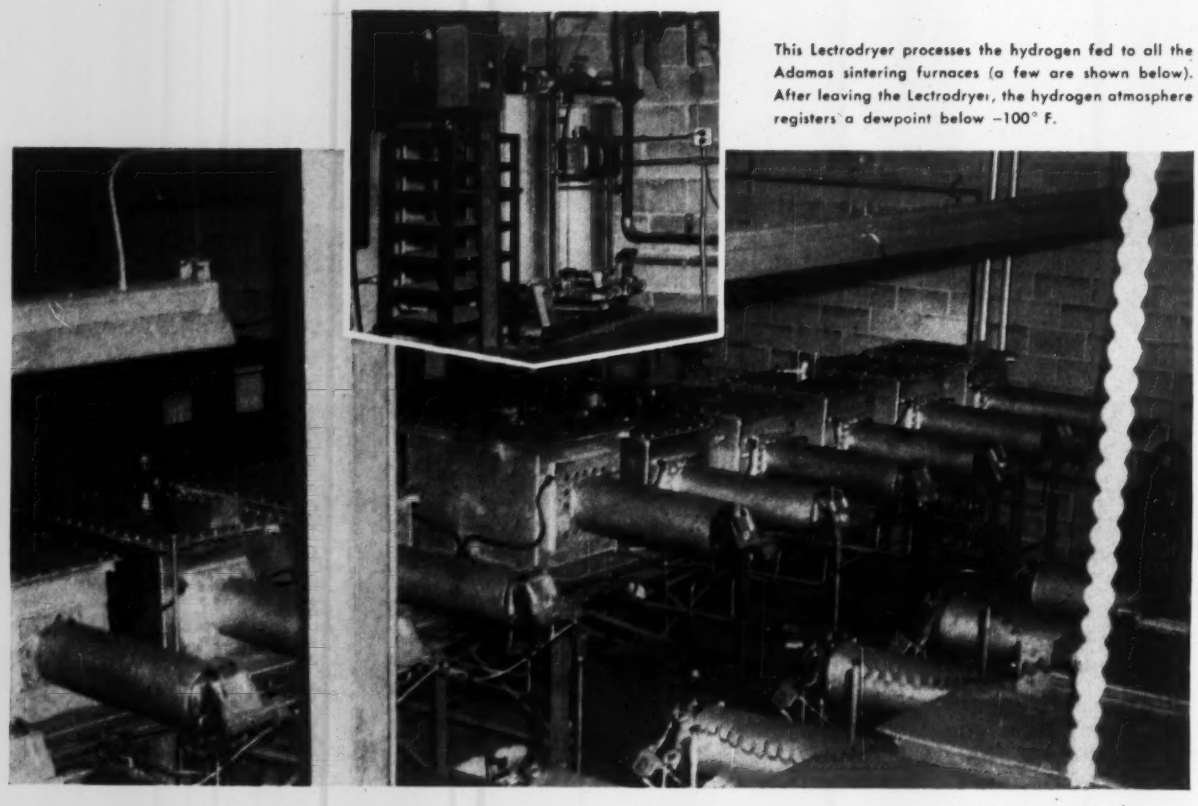


This Lectrodryer processes the hydrogen fed to all the Adamas sintering furnaces (a few are shown below). After leaving the Lectrodryer, the hydrogen atmosphere registers a dewpoint below −100° F.

Adamas Carbide insists on DRY hydrogen for sintering

Hydrogen dried to a dewpoint below −100°F prevents surface oxidizing of carbides being sintered at Adamas Carbide Corporation's ultramodern plant at Kenilworth, New Jersey.

To obtain such dryness, Adamas follows two steps:

(1) The hydrogen feeds through a catalytic cylinder which converts every trace of free oxygen into moisture.

(2) Then the hydrogen passes through a Lectrodryer* which snatches moisture from the gas, delivering it at a dewpoint somewhere below −100° F.

You can obtain similar dryness

Lectrodryers will economically remove unwanted moisture from air or other gases in a continuous, automatic cycle. For large or small volume—low or high pressures (to 6000 psi)—Lectrodryers of all types and sizes are available to solve your problem.

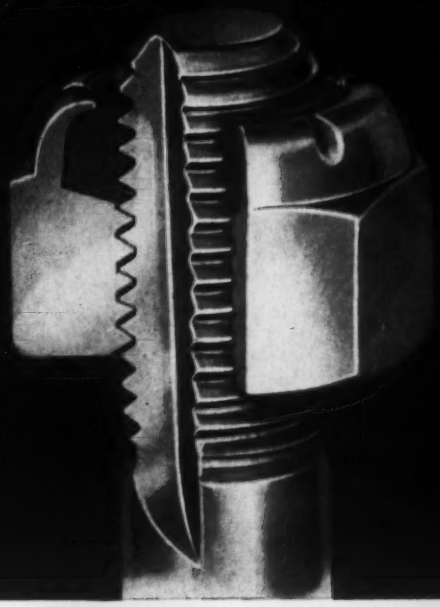
Talk it over with a Lectrodryer engineer. The booklet, *Because Moisture Isn't Pink*, describes how industry is using Lectrodryers. For a copy, write Pittsburgh Lectrodryer Division, McGraw-Edison Company, 335 32nd Street, Pittsburgh 30, Pennsylvania.

In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

Lectrodryer

*REGISTERED TRADEMARK U. S. PAT. OFF.

The nylon collared Elastic Stop nut never damages bolt threads!



The nylon locking insert * will not seize threads, gall or remove plating

The red nylon locking collar is an integral part of an Elastic Stop nut. Oversize in diameter in relation to standard bolt tolerances, this insert grips the entering bolt threads with strong, smooth nylon fingers that dampen impact loads and resist turning under the most severe conditions of vibration or shock. The perfect fit between bolt threads and the locking collar also serves to seal off internal bolt and nut threads and to protect them against corrosion. Furthermore the nylon insert is impervious to gasolines, oils, salt atmospheres, cleaning compounds and common acids. The remarkable wear resistance of nylon plus its elastic recovery makes Elastic Stop nuts reusable through more than a hundred on and off cycles.

Because an Elastic Stop nut is a one-piece unit it is less expensive to install than castellated nuts and cotter pins, or double nuts. Equally important, it is a *stop* nut that *locks at any position on the bolt* without requiring secondary "safety" devices; it is simple to adjust precisely—it is easily wrenched off or readjusted. Elastic Stop nuts have been used by American industry since 1930 to solve the toughest applications on railroad, automotive, earth moving and farm equipment, as well as on all types of electrical machinery.

Elastic Stop nuts are available in sizes ranging from a watchmaker's 0-80 through 3", and in many standard finishes and materials including carbon and stainless steels, brass, duronze and aluminum.

ELASTIC STOP NUT CORPORATION OF AMERICA

also maker of the ROLLPIN TRADEMARK

*The Red Locking Collar is a Registered Trademark of ESNA

Elastic Stop Nut Corporation of America
Dept. N27-711, 2330 Vauxhall Road, Union, N. J.

Please send me the following free fastening information:

☐ ELASTIC STOP nut bulletin

☐ Here is a drawing of our product. What self-locking fastener would you suggest?

Name _____ Title _____

Company _____

Street _____

City _____ Zone _____ State _____

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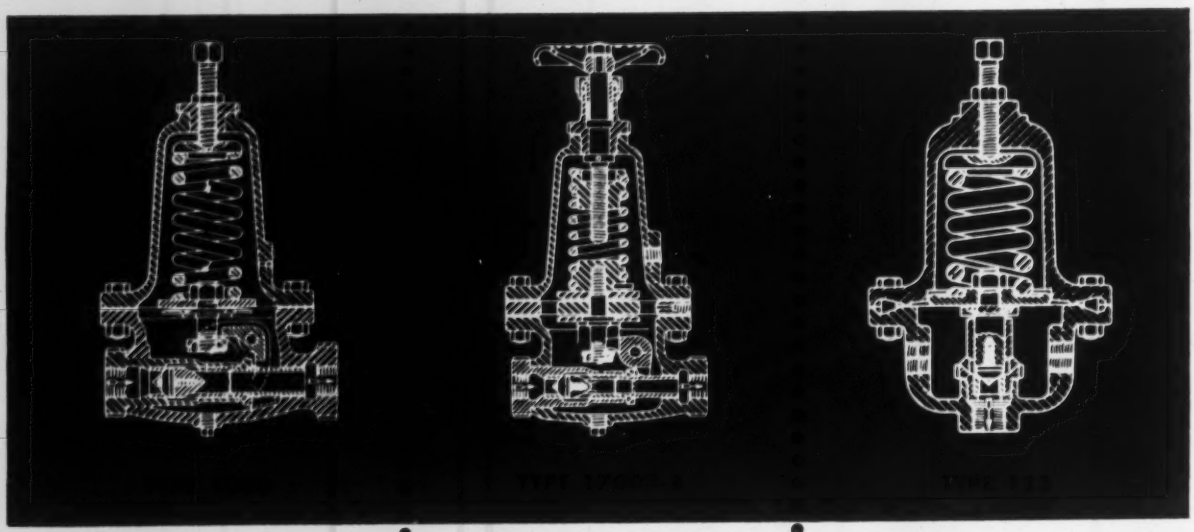


PRESSURE REDUCING VALVE

A streamlined high capacity valve for close pressure regulation—accurate even under toughest working conditions. Closes against the flow, eliminating conditions that cause chatter. Two types available: for high pressures and for low pressures. Recommended for steam, water, air, oil and most gases and chemicals. Screwed ends, sizes: ¼″ to 2″.

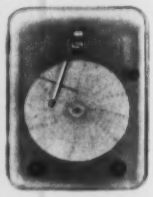
DIFFERENTIAL CONTROL VALVE

Maintains constant differential pressure between atomizing steam and fuel oil. Non-rising type adjusting screw adjusts spring either under tension or compression for maintaining steam above or below fuel oil pressure, depending on type of burner employed. Iron, bronze or steel body; bronze or stainless steel trim. Screwed ends, sizes ¼″ to 2″ with expanded outlets when desired.

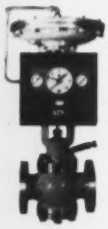
RELIEF VALVE

Maintains a desired inlet pressure by relieving into relief line provided or protects equipment against high pressure line surges. For water, oils, air, gases, slurries and many other fluids. Bottom connection is outlet or discharge connection. Two side inlet connections permit installation in the line or as an angle valve with one side inlet plugged. For relief pressures to 325 lbs. and temperatures to 500° F. Screwed ends, sizes: ¼″ to 2″; flanged ends, size ½″.

Cash Standard
Stacon Series V Self Operating Temperature Regulators

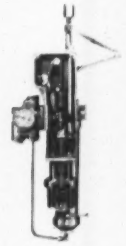


Type 57
Recording Controllers



Type 30
Diaphragm Control Valve With Type 51 Indicating Controller Mounted

Type 44
Pilot Operated Pressure Regulator



Type 100
Positioning Controller

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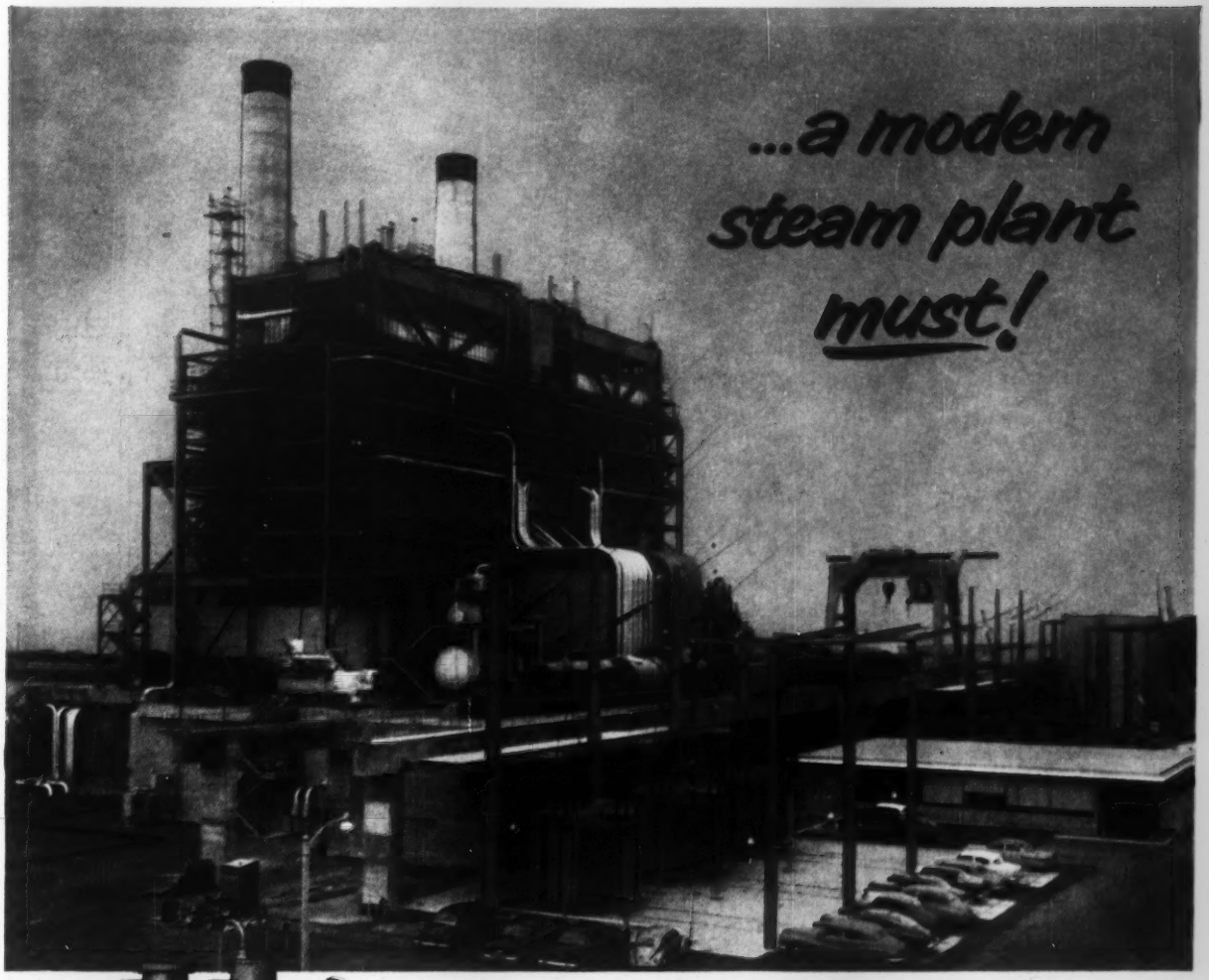

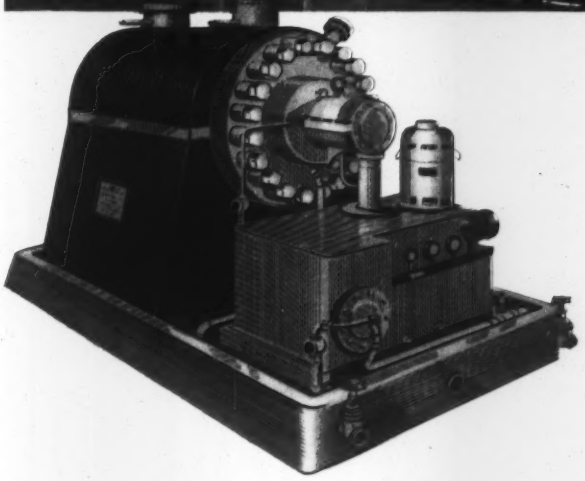

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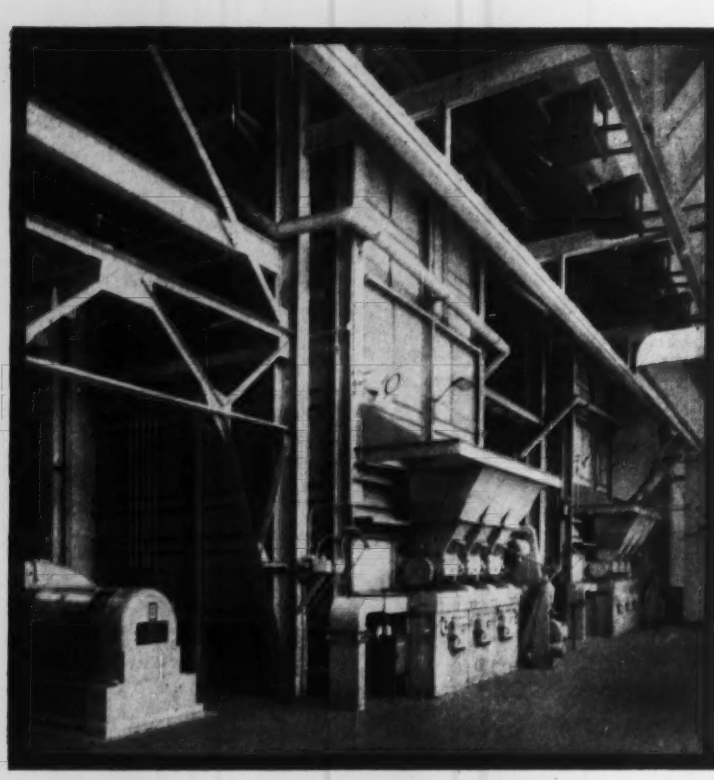

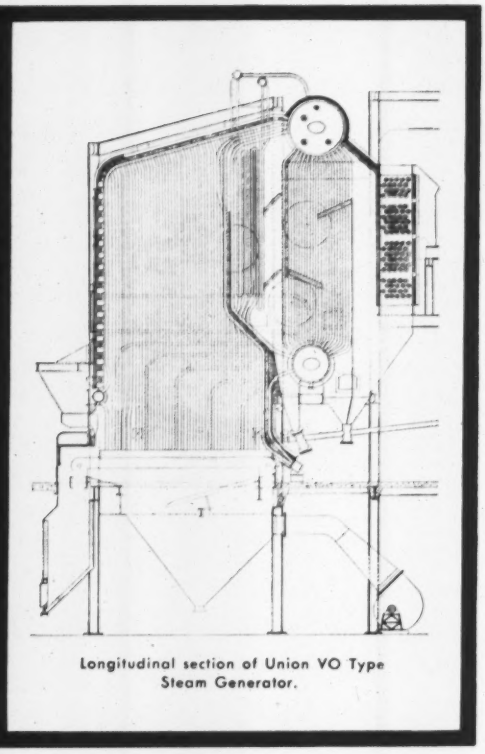

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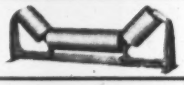 500	Often the most economical for continuous service. Carries more than the 100, less than the 400.	Serves same field as the 400, but where less capacity is handled and headroom is not a factor.
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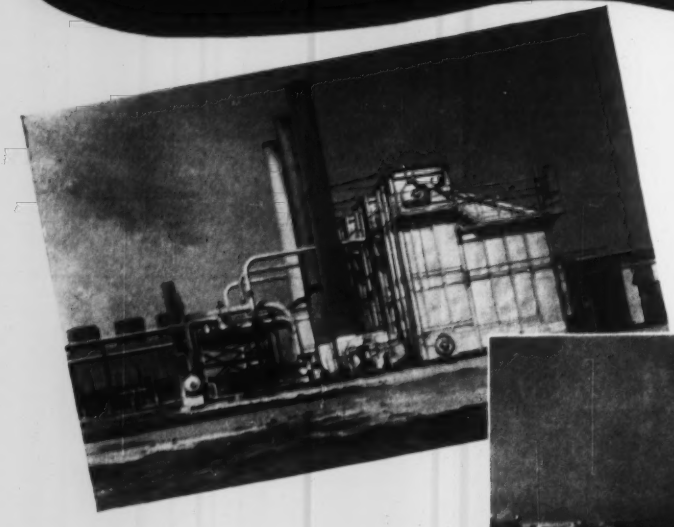
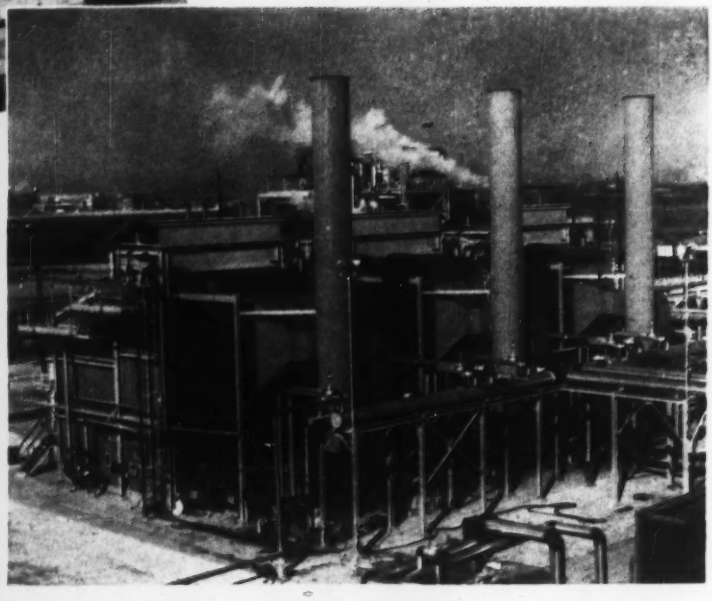


Three 85,000 #/hr. steam generators in a Texas refinery.



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Ventilating Fan for Tunnel

A combination of 11 blower and 13 exhaust fans ranging from 120,000-cfm to 320,000-cfm capacity will make a complete change of air every $1^1/_2$ min in the new third tube of the Lincoln Tunnel connecting New York and New Jersey. The centrifugal-type nonoverloading fans with backwardly inclined blades were manufactured at Westinghouse's Sturtevant Division, Hyde Park, Mass.
Ducts which occupy 40 per cent of the tunnel space inject fresh air at roadbed level and exhaust it through overhead openings.

Volume 79 • Number 7

JULY 1957

George A. Stetson, *Editor Emeritus*
J. J. Jaklitsch, Jr., *Editor*

MECHANICAL ENGINEERING

TOWARD UNITY?

A Message From the President

At most of my meetings with ASME Sections throughout the country I have been asked what progress is being made toward unity of the profession. My answers have seldom been considered satisfactory. There is a feeling that the officers of the Founder Societies should be taking more vigorous action, and there is an obvious impatience on the part of many members for a more specific program and more rapid progress. To them this report may be of interest as evidence that the presidents of the Founder Societies are not unmindful of the desire for unity, and are accepting every opportunity for achieving it.

A few weeks ago, at the suggestion of the president of AIEE, the presidents of ASCE, ASME, AIEE, AIChE, ECPD, NSPE, and EJC and a representative of the president of AIME met in New York to discuss the possibilities of eliminating conflicts, competition, and duplication of effort in our over-all program for professional objectives. Discussions were entirely informal. There was complete agreement with respect to the desirability of limiting the activities of ECPD, NSPE, and EJC to certain specified areas where each appears to be in the best position to serve the profession, but there was some difference of opinion in regard to certain specific items in the program offered for discussion by the president of AIEE.

Obviously the presidents were not in a position to make commitments for their respective societies, but the AIEE Board has crystallized a specific program which was reported to the membership by AIEE President M. S. Coover in a message published in the June, 1957, issue of *Electrical Engineering* and reprinted on page 693 of this issue.

I, personally, would welcome parallel action by ASME and have so reported to the Council. At the recent ASME Semi-Annual Meeting in San Francisco, the Council members almost unanimously expressed sympathy with the AIEE program, and action by ASME is on the agenda for the Annual Meeting. The president of ECPD made a report, at their invitation, to the Board of Directors of NSPE, at their annual meeting in June, and recommended that NSPE give earnest consideration to revising its own program to eliminate competition and duplication of effort in certain specific areas.

One specific item proposed by AIEE has already been adopted, at least for the coming year. EJC will hold no General Assembly in 1958, but will join ECPD in a combined annual meeting in October, 1957.

All members of ASME are members of ECPD and EJC. Many are members of NSPE. I hope that all of us are sincerely interested in unity and that each of us will exercise his individual influence in the three organizations to eliminate what President Coover describes as "present confusion and duplication of effort," and I join President Coover in inviting "every contribution that you are able to make."

Wm. F. Ryan

President, ASME

ELECTRONIC DATA PROCESSING MACHINES

Controls for design and engineering procedures

By D. H. Ware,[1] W. J. Martiny,[2] and F. J. Maginniss[3]

General Electric Company, Schenectady, N. Y.

IN ADDITION to the many applications in accounting and business, electronic-data-processing machines, EDPM, are giving us new opportunities in all activities of engineering from research and development studies, major design planning, production-engineering design calculations, on through the documentations of engineering information leading up to the generation of manufacturing instructions.

Versatility of EDPM

Each of these applications could make use of different equipment. On some problems, large memory and input-output capacities are required with relatively low computational speed. In others, computational speed is necessary with lower requirements for memory, input, and output. Occasionally, remote instrumentation of data is desirable. By compromising to some degree in the application of electronic-data processing to each of these activities, it is possible to perform all of them on a single machine, usually resulting in an over-all economy.

Engineering work calls for the predetermination of the performance and information leading to the cost of the product or its components and the selection of the best from the alternatives. It should therefore be an objective of engineering management to control the quality of these decisions, constantly improving their accuracy, and reducing the cost of obtaining them.

[1] Manager of Engineering. Mem. ASME.

[2] Project Engineer, Computers, Medium A-C Motor and Generator Department. Assoc. Mem. ASME.

[3] Manager, Special Engineering Investigations.

Contributed by the Management Division and presented at the Fifth Annual Engineering Management Conference, Pittsburgh, Pa., March 27–28, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS and the American Institute of Electrical Engineers. Condensed from ASME Paper No. 57—MGT-2.

Control of Engineering Decisions

A more effective control of engineering decisions through the use of EDPM can be realized in several ways. These include:

1 Removal of restrictive assumptions and the setting up of far more realistic mathematical models of the product.

2 Investigation of specific designs in far greater detail than was formerly feasible.

3 More complete standardization of the calculation approach.

4 Better control of standardization of parts where combinations of parts are selected from a predetermined program.

5 Complex calculations are brought to the command of less experienced engineers.

6 Less drudgery for all engineers.

In Research and Development

One of the principal advantages of using EDPM's in research and development programs is the opportunity to make a more detailed mathematical analysis before entering into the sample or model-building phase. This permits a faster completion of the project and more significant information from the tests on the samples built. It increases the breadth of the investigation and provides more background for decision making.

We have had particular success in the solution of the steady-state heat-transfer problem in induction motors. An analytical solution of this in the past has been inadequate because of the tremendous complexity of a complete calculation. Now, by programming a complete calculation once for the computer, many samples can be analyzed fairly simply in great detail and only the more promising used for sample building and testing.

Another aid to research and development is the use of EDPM's to make the results of research and development studies available to the entire organization. By programming the analysis of a complex problem it becomes possible to calculate the results without an extensive study of written materials.

An illustration of this in the field of induction-motor design is the calculation of the speed-torque relationship of a motor, including the effects of slot and mmf harmonics. This problem usually requires many years of experience. The availability of a calculation procedure which would predetermine the results of choices of such things as number of slots or winding pitch enables the designer to have more freedom in satisfying the customer requirements and at the same time insures management of a standard approach and reliability of decision.

Electronic-data-processing machines are applicable to nearly all engineering activities, resulting in more efficient engineering operations, and more effective management control. They broaden the base for decisions, speed up research and development studies, and force standardization of procedures as well as products. The gains from an integrated data-processing system are sizable, but the problem of selecting the equipment, and recruiting and training the operating staff also are sizable. On a large project, several years may be required to regain the starting costs out of the savings from using the system.

Production-Engineering Applications

In production engineering many lengthy and involved calculations are made on special products sold in small quantities which are really derivatives from the standard line. By reducing the longer calculation procedures to a program for an electronic calculating machine, a standardization of procedure is forced, and all calculations will be complete and based on the same premises and assumptions. This standardization enables a fairly rapid comparison of the results of test against design.

Common variables may be cross-plotted and checked more readily on the total product under all normal operating conditions rather than restricting these checks to a few standard designs. This procedure assures more extensive control at the very lowest decision-making level and it also permits a more precise and detailed understanding of the effects of these uncontrolled variables at the higher level of decision making.

In many cases a shortage of engineering manpower may compel the use of EDPM's to extend competent decision making to the less experienced engineers without sacrificing freedom of action yet maintaining assurance of satisfactory performance.

Engineering documentation and generation of manufacturing instructions are quite similar to most production and manufacturing activities. In engineering we can effect a certain amount of inventory control by using cross-checking programs to eliminate, for example, the possibility of two drawing numbers or two model numbers for the same part. Use of such EDPM's in this area has the attendant advantage of determination of specialties which are being sold or products or parts being built in sufficient quantity to justify standardization or extra design effort to reduce variety.

One of the most important advantages to management from the use of EDPM's for generating engineering documents is that it permits much more widespread and effective use of EDPM's in all of the functions dependent upon these documents. Most of the identifying information for parts, subassemblies, and complete units is generated by the engineering organization. Once these identifying numbers are made suitable for use on electronic equipment, any of the other functions would be able to use these numbers directly and not be obliged to provide conversion routines or abbreviations of numbers which may become so complex as to make the whole process unwieldy.

In these examples we have attempted to illustrate that there are real gains to be made in the effectiveness of an engineering operation in making crisper decisions, in control of standardization, and in control of the engineering operation itself.

Personnel and Techniques

Personnel and techniques for using digital computers and other data-processing equipment effectively are not readily available. The machines have delivery dates which range from 18 months to 2 years, but the bottleneck is in building up the staff of trained personnel required to make effective use of them. It is estimated that for the next few years only about 10 per cent of the trained personnel required for the most effective application of digital computing equipment will be available.

There are three problems which management must face. First, a specialized type of personnel training is required particularly for engineering applications. Second, the type or types of equipment which will satisfy the varied requirements of the over-all organization must be chosen. The third problem involves setting up proper techniques. We do not necessarily solve a problem or go through a data-processing operation the way we do manually. A good deal of study and research is required here. One of the hidden benefits of a thorough analysis of methods is the savings in dollars made possible by improvements in methods alone which can be effected long before they are applied to automatic computing machinery.

Personnel Training Must Come First

Engineering management should waste no time in providing some organized training course for a number of employees, including key personnel who will be closely associated with and responsible for the application of the machines. There is a continuously growing number of organizations which provide such training. Both the computer manufacturers and the universities offer courses of study which develop an understanding of the basic operation of the digital equipment and a knowledge of business techniques and numerical methods. Many industrial organizations have set up their own training courses, and it is certainly possible for a newcomer to the field to do the same thing by bringing into the organization a man well trained in all these techniques. A final way of obtaining this training fairly rapidly and effectively is to make use of rental computing equipment. It is usually possible to get assistance in setting up and solving problems on this rental equipment, and it affords one the opportunity to evaluate different types of machines while learning by doing.

The use of electronic-data-processing equipment offers high returns, but must be supplemented by substantial investment in training effort, time, and money.

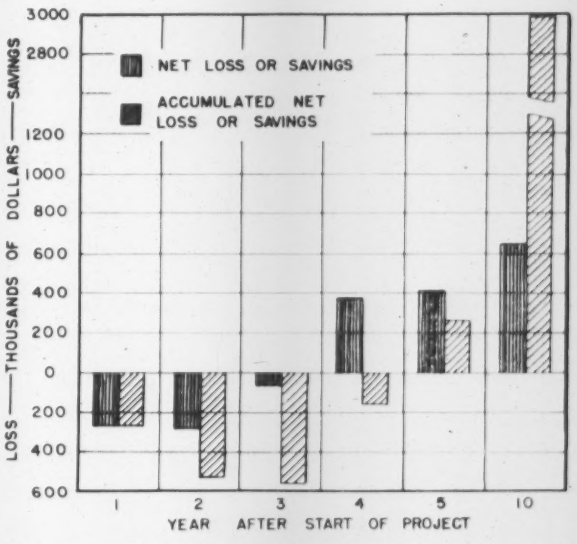


Fig. 1 The savings that are indicated in an actual project of applying a fairly complex set of problems and the related communication system to an electronic-data-processing machine

PROCESS ENGINEERING PROBLEMS in the Hanford Separation Plants

By Charles A. Rohrmann[1]

General Electric Company, Hanford Atomic Products Operation, Richland, Wash.

THE General Electric Company operates the facilities needed for the production of plutonium at the 600-sq-mile Hanford Project in Benton and Franklin Counties, Wash., for the Atomic Energy Commission.

The plutonium-production facilities include plants for the fabrication of uranium metal prior to the radiation process, the piles or reactors in which the uranium is irradiated to produce plutonium, the separations plants where the uranium and plutonium are separated and purified, and other facilities for final preparation of the plutonium and uranium for shipment.

Irradiation of Uranium

Uranium for use in plutonium manufacture is a highly purified material containing the two isotopes in the ratio found in nature, about one part of the U-235 isotope to 140 parts of the U-238 isotope. The major uranium isotope on exposure in a reactor to neutrons of a certain energy absorbs some of these neutrons to form the U-239 isotope which rapidly decays to neptunium, which, in turn, decays to form the product, plutonium. The reactor operation, to be self-sustaining and to produce plutonium, must produce enough neutrons from the fission of the U-235 to provide for: (*a*) absorption in U-238 to produce the plutonium; (*b*) absorption in more U-235 to cause fission for the production of additional neutrons and (*c*) sufficient neutrons to allow for losses in the reactor structure and in the elements which are themselves produced from the fission of U-235, such as xenon-135.

Although enormous quantities of energy are dissipated in the fission reaction, this energy represents only a small loss in mass, insignificant from the standpoint of normal industrial material-balance arithmetic. Essentially, the U-235 which enters into the fission process is converted to an equivalent weight of neutrons and fragments. The radioactive products are isotopes of about 40 elements including chemically unreactive noble gases such as xenon, the isotopes of biologically important elements such as iodine, and other elements which are of concern because of their chemical properties, concentration, half-lives, or substantial contribution to the total activity.

Irradiation of the uranium in the reactor is continued until the plutonium content is built up to a suitable level. The metal is then discharged and stored for a time sufficient to minimize concentration of isotopes of shortest half-lives and to let substantially all of the neptunium decay to plutonium.

Uranium and Plutonium Separation

After the aging period, the irradiated uranium is ready for treatment by the separations processes which separate the uranium, plutonium, and fission products from each other. The recovered uranium, which still contains appreciable amounts of U-235 must be subsequently processed by normal industrial techniques, including manual handling for recycle to the irradiation process or for extraction of the U-235 isotope. Therefore the purification requirements are extremely rigid. The radioactive fission products which exist in irradiated metal, in amounts of the order of parts per million and less, are reduced to levels of about one part in ten million of the parts originally present or, in other words, to levels of parts per 10^{13} or parts per ten thousand billion. Because of its extreme biological toxicity, the plutonium in the uranium must be reduced to levels of 0.1 part per million.

Disposal of Separations Process Wastes. Because of the long half-lives of certain fission products and also because of the residual amounts of plutonium, these wastes must be securely stored indefinitely.

The radioactivity of the fission products results in the phenomenon of self-heating of the wastes. For the most active wastes, the boiling temperature may be maintained for a period of years, and storage facilities must provide for the controlled dissipation of such heat.

[1] Manager, Engineering Development Planning Operation.

Based on a paper contributed by the Nuclear Engineering Division, presented at the Spring Meeting, Portland, Ore., March 18–21, 1956, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, and revised by the author in January, 1957.

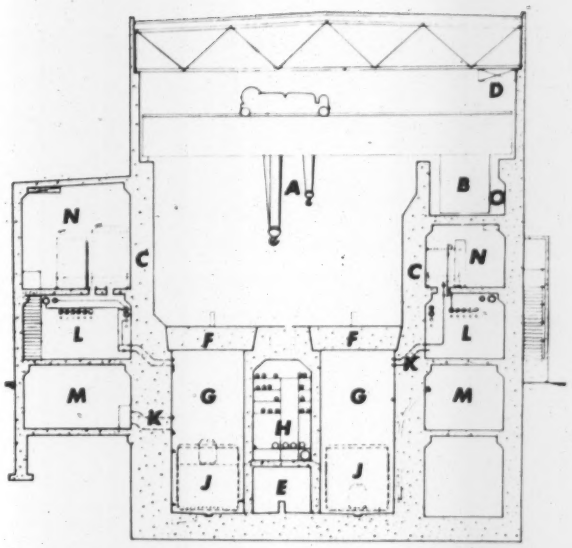


Fig. 1 Cross section of the Radiochemical Plant which is arranged with equipment cells on either side of the pipe tunnel. Note the crane with its shielded cab for limited remote handling operations. A, crane; B, crane cab; C, shielding wall; D, ventilation air inlet duct; E, ventilation air exhaust tunnel; F, cover blocks; G, process cells; H, pipe tunnel; J, process equipment; K, service piping; L, pipe gallery; M, sample gallery; N, operating gallery and aqueous make-up facilities; O, crane cab gallery.

Critical Mass. The nature of fissionable material requires that amounts exceeding a certain mass cannot be accumulated in a space of a certain shape and dimension because of the potential for initiation of an uncontrolled fission reaction. This limits the batch size, handicapping the ultimate capacity attainments of the process and influences the economics.

The Separations Plants

Processes and Economics. Examples of the processes that can be used for the separation, purification, and isolation of plutonium are batch processes based on the precipitation or scavenging technique and processes based on continuously operated solvent extraction. The widely differing chemical properties of plutonium in different valence states provide the basis for the successful operation of either kind of process. In the batch precipitation or scavenging process, a bismuth-phosphate precipitate formed under special conditions of acidity, solution composition, and plutonium valence was used to extract the plutonium in high yield from solutions of irradiated uranium. The precipitate was also used to separate or decontaminate the plutonium from the fission products.

Economic considerations favor the continuous-solvent-extraction methods. The batch operations are inherently more costly, and the chemical costs for the particular processes employed ars unusually high, as are the volumes of the wastes requiring expensive storage.

The Buildings. The buildings which contain the separations-process equipment are characterized by having the equipment separated from the operators and environs by several feet of reinforced concrete for protection from the hazardous radiation. The equipment is maintained by an overhead crane with a heavily shielded cab. Line-of-sight viewing of any of the equipment is prevented by a thick concrete wall, and all viewing of the equipment and manipulation devices is done through a periscope. In general, equipment which comprises a certain step of a process is contained in an enclosure or cell separate from other equipment.

The arrangement of the equipment is in a line from one end of the building where the processing begins to the opposite end where the finished products emerge. Flow of process fluids between cells of equipment is from the cell to another completely shielded section of the plant called the pipe tunnel, then back into the required cell. A long building may be used where cells and pipe tunnel lie parallel. Several arrangements are possible. Fig. 1 shows a cross-section of a plant with equipment cells on either side of the pipe tunnel. Fig. 2 shows a cross-section of a plant with equipment on only one side of the pipe tunnel. Note the simplification obtained with only one gallery side. Fig. 3 is a plan view of a plant showing the segregation of equipment in cells and the arrangement of the control room, the pipe and sample galleries, the pipe trench, and auxiliary service areas. Fig. 4 is a sketch of the interior of a canyon, showing the removable cover blocks which close all cells, except when irradiated uranium is first brought into the plant for processing, or during maintenance, or nonroutine inspection.

Process Equipment. All process equipment, including reaction vessels, centrifuges, pumps, agitators, evaporators, control valves, liquid-liquid contactors, and rotame-

Fig. 2 Canyon cross section of a plant arranged with equipment on only one gallery side. Processing is in a line from one end of the building to the other, with the flow of process fluids from one cell to the pipe tunnel, and then back into the next cell. Each cell is a completely shielded section of the plant, devoted to a single stage in the process, and the pipe tunnel is also shielded to protect personnel from radiation.

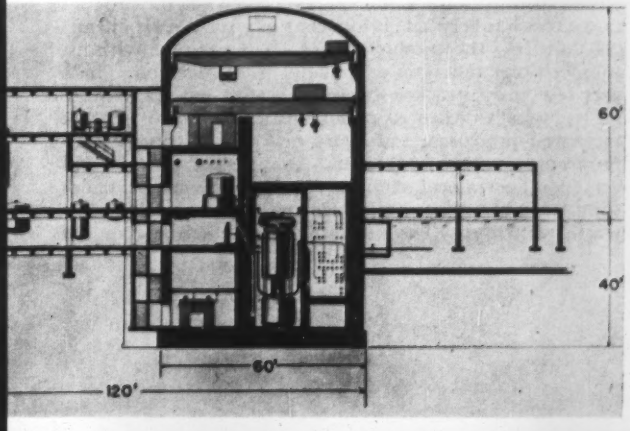
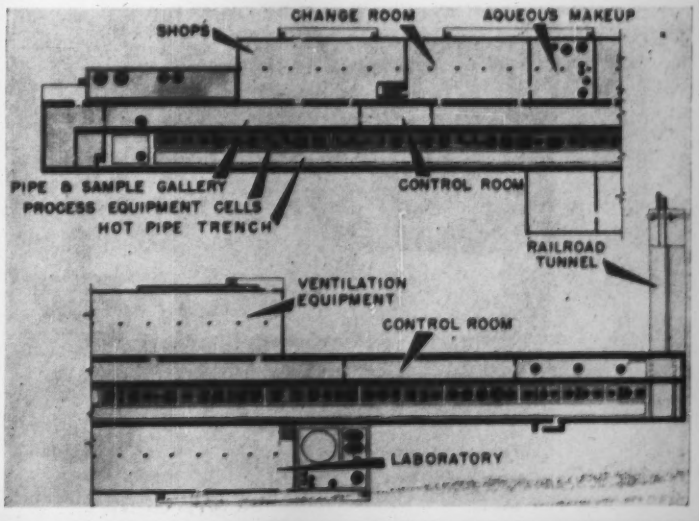


Fig. 3 Separations plant floor plan. Process equipment cells are arranged in a single line, parallel to the hot-pipe trench.



ters carrying radioactive solutions, is assembled, connected, and disconnected by manipulation from the crane. All such equipment is accurately positioned in the cell with respect to adjacent equipment, and an arrangement of wall nozzles which provides connections to all the required services for each piece of equipment. The hook-ups for delivery of chemicals, power for agitators and pumps, air, steam, and water as well as for instrumentation such as thermocouples, pressure-sensing devices, liquid-level and specific-gravity-measuring equipment, audio equipment, and lubrication for moving parts, are all made by a "remote" connector, Fig. 5.

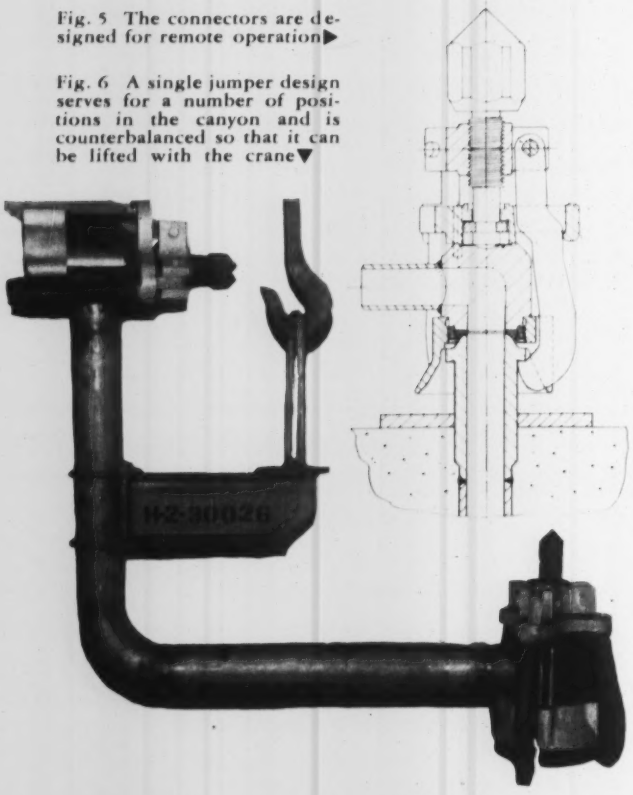
Jumpers. A very useful device for adaptation to remote maintenance is an assembly consisting of a length of pipe with a remote connector at each end, called a jumper, Fig. 6. This is balanced by counterweights and positioning of the lifting bale so that it can be lifted with the crane and lowered into position to precisely engage the connector heads with corresponding wall and vessel nozzles. Some jumpers have three heads which must be so engaged. Standardization of vessel dimensions and orientation with respect to the wall nozzle pattern allows a single jumper design to serve for a number of positions in the canyon. For ease in maintenance, stacking or crossing of jumpers over one another is avoided wherever possible. Prior to installation in the plant, all vessels, process equipment, and jumpers are assembled in the "lock-up" shop. This has equipment mountings and dummy wall nozzles which from a position and orientation standpoint are identical with those in the separation plants. Such mock-up testing assures that equipment, as-fabricated, will fit in the production plant. A typical cell arrangement is shown in Fig. 7.

Similar to Other Industrial Equipment

In general, most of the vessels and process equipment do not appear much different from those normally seen

Fig. 5 The connectors are designed for remote operation▶

Fig. 6 A single jumper design serves for a number of positions in the canyon and is counterbalanced so that it can be lifted with the crane▼



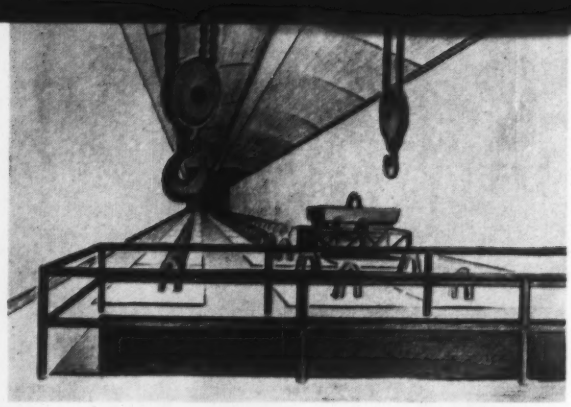


Fig. 4 Interior view of the canyon. The removable cover blocks close all cells except when irradiated uranium is first brought in, or during maintenance and inspection operations.

in industry except for changes in shape to provide maximum capacity in the limited space of a cell. Instead of the usual flanges, all vessels have male nozzles to which the remote connector may be attached for the required hook-up. Motorized equipment must have nozzles for remote attachment of lines for power and lubrication. For equipment such as evaporators, the pot, column, vapor lines, and condenser are generally separate pieces which are assembled remotely by the crane. Dowels and guides are used to assist in assembly, and to assure proper alignment of pieces during remote attachment.

The crane, with its single operator, performs all maintenance that can be done with all equipment in contact with radioactive materials. Such maintenance is, however, quite limited. Most work involves replacing failed or defective equipment with new. Components which are to be repaired are transported elsewhere. Essentially, no disassembly and assembly of equipment to be repaired are done in the separations plant. By far the largest portion of the operating time of the crane is involved in charging dissolvers with the irradiated uranium which is to be processed. Maintenance on the crane itself is done manually in an area at one end of the canyon.

The ventilation system prevents radioactively contaminated fumes and dusts from drifting into personnel areas of the plant and escape to the plant environs. By an extensive exhaust system, the cells are kept under reduced pressure with respect to the rest of the canyon, and the vessels are maintained at pressures slightly lower than that of the cells.

Problems

At the beginning, the program for production of fissionable material had the single objective of contributing to the rapid conclusion of World War II. Since the end of World War II, the production of fissionable material has continued for security reasons. The effect of large expenditures in the separations phase of the production effort has been much like that in a large-scale chemical industry, the product of which is entirely without competition, and is in extremely heavy demand. In a very few years, processes were developed and plants were built; which presented opportunities for use of greatly improved processes, and every new major construction program involved substantial changes in process and design. Specialized equipment for performance under conditions of radioactivity was new to large-scale industrial operations. The pressure for production required

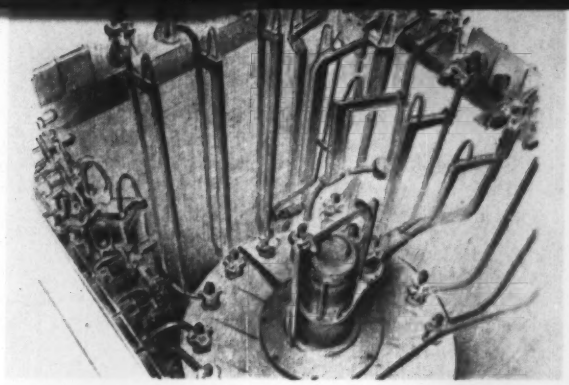


Fig. 7 Typical cell arrangement with a variety of jumpers attached. These are balanced by counterweights so they can be lifted with the crane and lowered into position.

the capacity operation of all facilities with major efforts directed at further capacity improvement. Equipment failures were erratic and in most cases impossible to investigate adequately because of inability to decontaminate the failed equipment to levels which would permit inspection.

Because of the intense radioactive contamination, most of this equipment is discarded and replaced with new. In general, an adequate stock of such equipment is on hand ready for installation or can be rapidly modified for such installation.

Accumulation of Fission Products

At a certain step in a separations process, the deposition and accumulation of one of the fission products was unexpectedly noted. When examining a stored piece of failed equipment preparatory to its burial, the crane operator observed that paint on the concrete floor on which the vessel had rested was darkened or scorched. It was still hot enough to generate steam when water was sprayed on it several months later.

In another vessel a solution was pumped continuously over a packed tower. On one occasion the circulating pump failed. The failure was not corrected for several hours. On restarting the circulation of the solution, the system was pressurized by the solution being suddenly brought to the boiling temperature by the heat of radioactive decay of an accumulation of fission product. These incidents are characteristic of the peculiar properties of the materials processed in a plant for the separation of highly radioactive elements. Except for the design of the container in which failed equipment is buried, little consideration has had to be given to the design of facilities to accommodate such incidents. In the case of the circulating pump, instrumentation is provided to indicate circulation, and equipment is on hand to allow nonroutine continuous addition of solution from head tanks whenever the pump is inoperative.

In one of the separations plants, for a few years after start-up, the frequency of failure of heating coils was a major problem, with some of the most costly and vital equipment lasting for as little as three months. In one instance, it was barely possible to fabricate on site spare equipment fast enough to keep up with failures which involved an evaporator used to concentrate acidic solutions containing substantially all of the waste fission products. This evaporator had its heating coils built integral with the vessel, and failure of the heating coil necessitated discard of the whole assembly because of inability to sufficiently decontaminate the equipment to allow repairs.

After a particularly rapid and surprising failure, an intensive effort was made to decontaminate the vessel which reduced the contamination to a level where close inspection and removal of specimens were possible. All such equipment is fabricated of stainless steel of a type which has shown satisfactory corrosion resistance in laboratory tests, but examination disclosed a surprising example of gross, uniform corrosion. Upon removal, a section of pipe which should have weighed about 70 lb could be supported by one's index finger! A change to another type of stainless steel, along with improved specifications, workmanship, and inspection, have all contributed substantially to the life of this equipment.

The greatest single advance in the progress toward minimizing the costs and consequences of unexpected failures was use of removable heat-transfer bundles so that production could be maintained if one of the bundles failed. Fig. 8 is an illustration.

Utilizing design types which make use of relatively few bolt holes reduces to a minimum the time required to bolt up a flange by the remote crane. This introduces problems in gasketing to obtain adequate sealing. Radiation effects, as well as chemical attack, limit the choice of gasket materials, with the tendency being a combination of materials. An outer material is used to give resistance to radiation and chemical effects, and an inner material to provide resiliency. The present trend is toward providing all gaskets in special, rigid

Fig. 8 Removable heat transfer bundles simplify maintenance of evaporators and make discard of the expensive vessel unnecessary

mountings or supports to permit replacement by remote means.

The disposal of failed and contaminated equipment requires boxing in a nearly airtight container to prevent the leakage of contamination when the equipment is transported to the burial pits by railroad. To minimize radiation exposure of the train crew, several spacer cars are used between the locomotive and the car carrying the load. At the burial pit the box is drawn from the railroad car by means of a long cable attached to a tractor.

Although the process chemistry has been firmly established by the time a separations plant is built, process changes may be justified to improve safety, product quality, capacity, or economics. Those changes involving alterations in the cell equipment present the greatest problems. Capacity increases may require the design of odd-shaped vessels which necessitate unusual structural features. The absence of sufficient spare wall connectors in desired positions may require alternate routings to be developed. Fortunately, standardization of the wall-nozzle pattern, flexibility of nozzle utilization, and the foresighted provision of a number of spare nozzles, have permitted a variety of changes to be made to achieve desirable results.

Where a required improvement which involves processing of radioactive materials cannot be accommodated inside an existing separations plant, facilities are designed for outside construction and operation. Pit-type construction is utilized so that a mobile crane can be used for maintenance. Instead of the complex periscopic optical system which is used on the remote canyon crane, mirrors or direct-viewing from a distance are used to direct the operation of the mobile crane. Remote connectors and jumpers are provided as in the in-canyon cells.

Storage Problems

Since the start of the separations operations, as seen in Fig. 9, liquid waste solutions containing substantially all of the fission products were made alkaline and stored in large underground steel-lined concrete tanks. Although this method was costly when the millions of gallons of wastes to be stored were considered, it was effective and, for the moment at least, appeared to have been a satisfactory industrial method for disposing of the waste. To avoid the carrying of radioactively contaminated particulate matter out of the tanks with vapors resulting from this self-heating, the underground tanks had finned-tube, air-cooled condensers mounted on them. The small amount of condensate formed was refluxed to the storage tank. As process improvements were made, the fission-product concentration in the waste increased. This, in turn, increased the rate of heat generation to the point where air condensers were no longer adequate. Water-cooled condensers were then adopted. At this time, vapor evolution reached such magnitudes that substantial economies in waste storage could be realized by letting the waste concentrate itself. By comparison with normal heat sources, the energy release is small amounting to only a few watts per gal in even the most concentrated wastes, but with millions of gallons in storage, the total is substantial, and remotely operated evaporation facilities would be costly and time consuming.

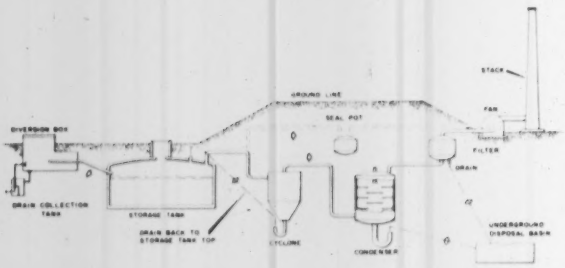


Fig. 9 Schematic elevation view of a typical High-Level Waste Storage Facility

The low rate of heat release per unit of volume and per unit of surface area in the large storage tanks results in very low rates of convection within the liquid. This, in turn, encourages the development of superheat in the substantial temperature gradient from top to bottom in the mass of waste liquid. In addition, the formation and deposition of precipitates concentrate some of the fission products, which contributes to the heterogeneous nature of the energy-release phenomenon. Heat is stored as superheat in the liquid and also in the precipitates. Eventually, the unstable system is disturbed by liquid movement. The heat, in the form of steam, is released suddenly and initiates rapid boiling, with steam releases on the order of 10 to 20 times the nominal heat-liberation rate. Because of the pressure which is developed by the steam surge, coupled with the pressure-drop restrictions in the vapor-headering system, some of these eruptions have been cyclic and have continued at intervals of about one-half a minute until the available stored energy is exhausted. Prolonged periods of boiling at much-higher-than-nominal rates with only moderate pressure increases have also been observed. Newer facilities with adequate condenser capacity, together with pressure relief and de-entrainment facilities, are operated with satisfactory confinement of activity. Sufficient information and operating experience have since been obtained to show that only moderate agitation is needed to eliminate the eruption problem. The equipment for inducing agitation is the gas lift. In this equipment, air is introduced at the bottom of a 1 to 2-ft-diam vertical pipe extending from near the liquid surface to near the tank bottom. The rising column of the air-liquid mixture produces circulation rates of thousands of gpm with air flows of only a few cfm.

Future Problems

The future can be expected to present a host of new problems to the process engineer working in the field of fuel or separations processing. The fuels themselves may be complex assemblies of a variety of materials, alloys, and combinations such as enriched uranium (high in U-235), plutonium, uranium-233 (from thorium), stainless steel, zirconium, and ceramics. A high degree of chemical-and-mechanical-process flexibility will be required in the separations plants to handle such a variety of materials. Although present operations are concerned with aqueous processes, alternate processes may be developed. Isotope or specific-fission-product recovery from waste may also become important. In the field of design, efforts will continue toward developing simpler equipment with more application of standardized, interchangeable, and readily replaceable parts.

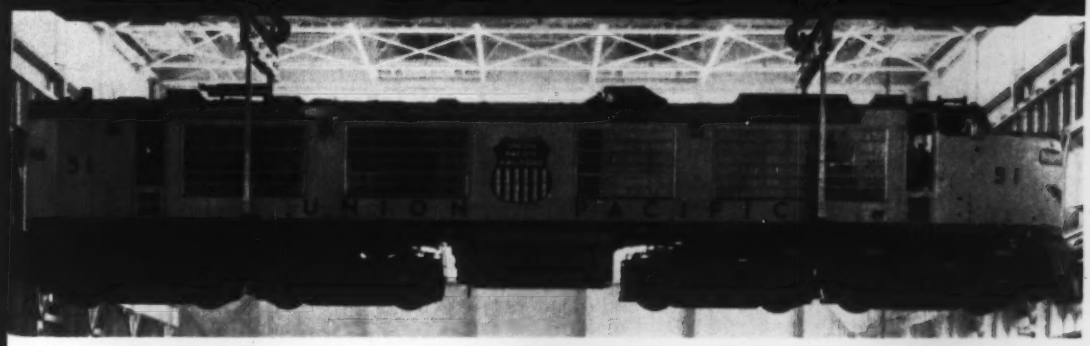


Fig. 1 One of Union Pacific Railroad's 25 gas-turbine electric freight locomotives in the shop for maintenance

Gas-turbine maintenance in severe service

By Ross C. Hill

Union Pacific Railroad Company, Omaha, Neb.

There are probably some power plants which operate under more severe conditions than do railroad locomotives. However, it is apparent that locomotive service is a severe test for any type of engine and associated control. In order to adapt equipment designed for aircraft life or stationary plant conditions to railroad service, much more attention must be given to strength and sealing.

Gas-turbine locomotives on the Union Pacific have never been required to endure a tropical monsoon nor negotiate passage through a typhoon or hurricane, but there are few other climatic experiences that have been missed.

Currently the 25 gas-turbine locomotives are assigned to freight service between Council Bluffs, Iowa, and Ogden, Utah. This run starts at 1000 ft elevation at the Missouri River, climbs steadily for 500 miles across Nebraska to 6000 ft elevation at Cheyenne. Thirty-nine miles west of Cheyenne the line peaks at 8000 ft elevation and then runs across Wyoming on a high rugged plateau, never dropping below 6000 ft elevation. The last 65 miles of the route drop down Weber Canyon in Utah to Ogden at 4300 ft elevation.

Weather conditions across the 1000-mile territory vary from hot and humid to very dry and dusty. Ambient temperatures from −30 F to +90 and 100 F are not uncommon. Dust and sand storms driven by high winds occur regularly. In winter it is not unusual to run through a horizontal blizzard with little if any snow stopping on the ground.

During operation the machine is subject to considerable vibration and shock from the rail and drawbar effects. In addition, surrounding air is contaminated with dirt from ballast and rail sanders. It is not feasible to provide complete air cleaning because of the large cleaning equipment which would be required.

The low-grade residual fuel required for economical operation imposes additional difficulties in combustion and fuel handling and adds to control complications.

Operating cycles make locomotive gas-turbine service much more severe than comparable service in a stationary power plant or pumping station. Track profile and traffic conditions necessitate frequent load cycling between idle and full power. A large number of shutdowns and startups are required to conserve fuel.

The first of the Union Pacific's 25 gas-turbine-powered locomotives, Fig. 1, was delivered in February, 1952. By the end of August, 1956, one of the turbines had accumulated 17,704 fired hours, with the balance graduating down to a minimum of 7332 hours. All of the 27 turbines, including two spares, have been out for modification and repair at least once.

Maintenance Problems

In the past four years, many maintenance problems have arisen, some of which have been solved. Since a study of all the problems encountered would be too lengthy for this paper, a record of the defects occurring

Contributed by the Gas Turbine Power Division and presented at the Gas Turbine Power Conference, Detroit, Mich., March 18-21, 1957, of The American Society of Mechanical Engineers. ASME Paper No. 57—GTP-4.

during August, 1956, has been selected as representative. During that month the 25 operating turbines accumulated an average of 432 fired hours.

Table 1 shows the number of defects occurring to gas turbines and associated control equipment. During August there was a total of 22 reported defects with 14 locomotives involved. The defects can be distributed as 15 control failures, five turbine-component mechanical failures, one case of wear, and one failure due to manufacturing error.

This fault distribution points up the fact that gas-turbine performance records are being seriously hurt by failure of auxiliary components which are not designed as well as the machine itself. This is a situation which demands attention. Realizing that precise regulation is required in order to extract the utmost in efficiency from modern machines, the job is only half done when the precision control is not mechanically able to do its job satisfactorily.

Many of the control failures can be classed as nuisances as far as repair costs are concerned, but they are very serious from the standpoint of reliable operation and costs chargeable to delayed trains.

Attempts to dig deeper into the reason for locomotive failures are often very frustrating. In all too many cases, the defect is transient and there may be many cases before the answer is uncovered.

Table 1 Gas Turbine and Control Defects—August, 1956

Locomotive number	No. of failures	Distribution			
		Control	Mechanical	Wear	Error
51	1	1			
52	2	2			
54	3	2	1		
55	1	1			
56	1		1		
58	3	1	1	1	
59	1	1			
61	1	1			
65	2	2			
67	1	1			
•69	2	2			
70	2		1		1
73	1		1		
75	1	1			
14	22	15	5	1	1

Note: Table shows only defects pertaining to gas turbine and gas-turbine control.

Analysis of Failures

For example, on August 24, Locomotive 51, turbine shut down for an unexplained reason. This caused a delay of two passenger trains and three freight trains. The turbine could have been restarted with little delay if it were not for a secondary failure which is chronic. The spark-gap ignition plugs, Fig. 2, are not reliable under the adverse conditions of a "Bunker C" shutdown. They are not able to ignite residual fuel and often become coated and ground out while fuel lines are being purged of heavy fuel.

With a reliable ignition system, failures of this nature could be relegated to nuisances rather than major delays.

Locomotive 52 experienced two failures, both of which are charged to control. On August 8, No. 52 lost 2 hr 10 min running time between Grand Island and North Platte because the inlet temperature control cut the power due to a false indication.

Investigation of the pneumatic-temperature-control system disclosed an air leak at a flare fitting. This failure is chargeable to poor selection of material, copper tubing, and the use of a flare connection at a point subject to high-frequency vibration.

The second failure occurred on August 8, delaying a train 1 hr and 30 min between Cheyenne and Laramie while getting a helper engine. While the indication was the same as for the previous failure, investigation failed to develop the reason. Following the investigation, the trouble did not recur.

On August 11, Locomotive 54 lost 40 min running time between Council Bluffs and Grand Island because of low power. This was again traced to a broken copper tube at a flared connection.

On August 24, Locomotive 54, turbine died at Echo—eastbound in Weber Canyon. It was necessary to get another locomotive because the turbine would not fire. Three trains were delayed. It was necessary for maintenance forces to make temporary repairs to high-voltage ignition-plug leads before the turbine could be started. Possible cause of the initial failure was located in a failed relay coil in one of the parallel flame-detector circuits. Ignition leads cause periodic trouble from insulation failure. Flame-detector circuits handle relatively weak signals generated by thermopiles. These are subject to trouble from insulation failure and high resistance junctions.

On August 8, Locomotive 54 was charged with unscheduled shop time to change out a failed atomizing air compressor, Fig. 3. This is a two-stage centrifugal compressor which boosts main-compressor discharge air approximately 2 to 1 for the air-atomizing fuel nozzles. It is driven by an extension from the turbine shaft. Impeller speed is approximately 52,500 rpm. The sleeve bearings on the impeller shafts have been judged to be marginal, since the majority of compressor failures have come from failed bearings. Bearings and shaft seals have been redesigned to improve the condition. It has been necessary to apply large vents from the bearing housing to prevent pressurizing the lube-oil tank through the bearing drains. Prior to this modification, it was possible to blow all the oil out of the tank and fail the turbine bearings.

On August 6, Locomotive 55 was held for unscheduled work consisting of replacing an electrically grounded flame-detector panel. Failure of the panels usually is caused by failed insulation.

On August 15, Locomotive 56 was held to change the atomizing air compressor because of slight pressurization of the lube-oil tank. This was not an effective remedy, so the locomotive was again held while investigation determined that the source of pressurization was in turbine main-bearing seals. It was necessary to remove the turbine and dismantle it to learn that the No. 3 bearing seal was worn due to vibration introduced by a clearance fit instead of the required interference fit of the spline hub at the flexible connection between turbine and compressor. This minor mechanical fault took the turbine out of service for 9 days during August. It was unfortunate that the failure occurred while the spare turbine was not available during compressor reblading. This machine had accumulated a total of 15,463 hr since it was put into service in February, 1952. It had been operated only 369 hr since the last disassembly to replace bearings wiped because the lube-oil tank had been blown dry.

On August 6, Locomotive 58, turbine failed to fire

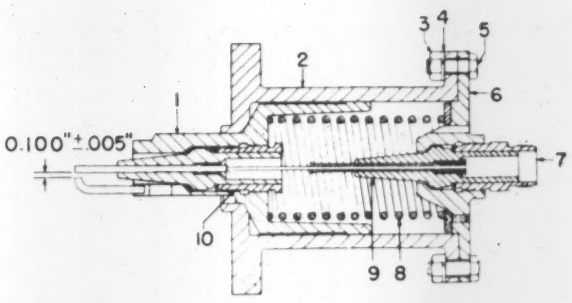


Fig. 2 Spark-gap ignition-plug assembly for gas-turbine electric locomotive (1 piston; 2 body; 3 nut; 4 lock washer; 5 bolt; 6 cap; 7 bushing; 8 spring; 9 core assembly; 10 bushing)

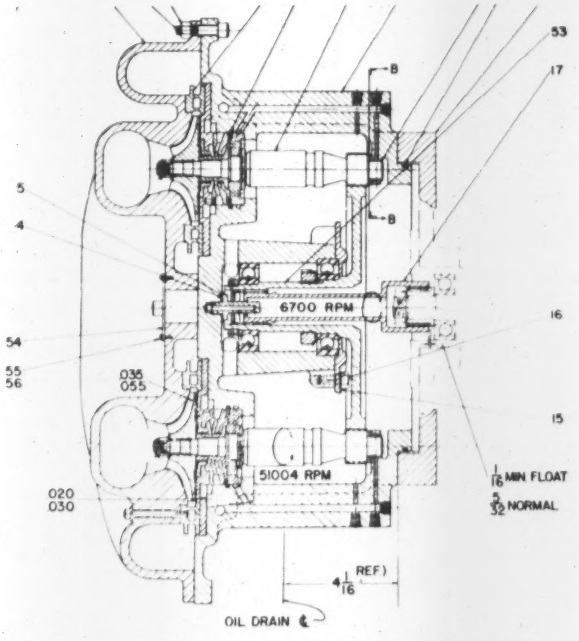


Fig. 3 The atomizing air compressor, a two-stage centrifugal unit which boosts main-compressor discharge air approximately 2 to 1 for the air-atomizing fuel nozzles, is driven by an extension from the turbine shaft

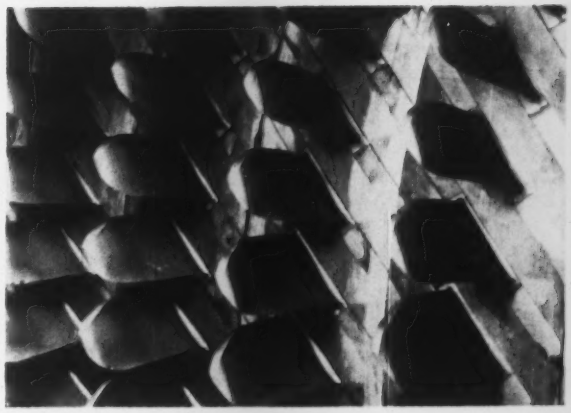


Fig. 4 Blade erosion on the compressor rotor is not fully understood, but the tentative pattern indicates that compressors will require reblading at about 15,000 hours under present conditions

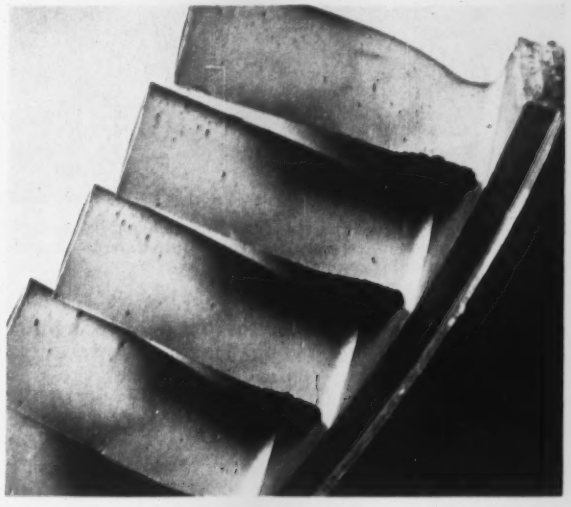


Fig. 5 Blade erosion on the compressor stator. Erosion occurs on the tips of the rotor blades and at the roots of the stator blades; hence excessive centrifugal stresses do not occur as a result of wear.

leaving North Platte, resulting in delays of 30 to 50 min to five manifest trains. Inspection developed that both spark-plug leads were shorted. In addition, the turbine alternator-field contactor was sticking, making it impossible to complete the turbine-cranking cycle.

On August 11, Locomotive 58, turbine was delayed 50 min on being unable to crank successfully after shutdown for test group to make adjustments in temperature control.

On August 15, Locomotive 58 lost 1 hr 30 min running time between Green River and Bitter Creek because of low power turbine. This defect was caused by eroded compressor blading, Figs. 4 and 5, which resulted in loss of compressor efficiency and net power. Blade erosion on the compressors is not fully pinned down at present, but the tentative pattern indicates that compressors will require reblading at about 15,000 hr under present conditions. Erosion conditions appear to be worse on the Wyoming Division, possibly due to the presence of fine cinders from coal-burning steam locomotives. One turbine which operated for 3000 hours between Los Angeles and Las Vegas showed a much slower-than-average erosion rate even though operation was in desert territory with occasional sand storms. On this run there are no cinders and no overhead coal chutes. Compressor air inlets are now on the roof of the locomotive with no filtering. This has eliminated blade fouling which occurred when air was taken inside the cab through viscous impingement-type filters. As seen in Figs. 4 and 5, blade erosion occurs at the tips of the rotor blades and at the roots of stator blades. This is fortunate since excessive centrifugal stresses do not occur as a result of wear.

Locomotive 58 suffered further delay at Rawlins on August 15 due to failure of a wire-reinforced neoprene

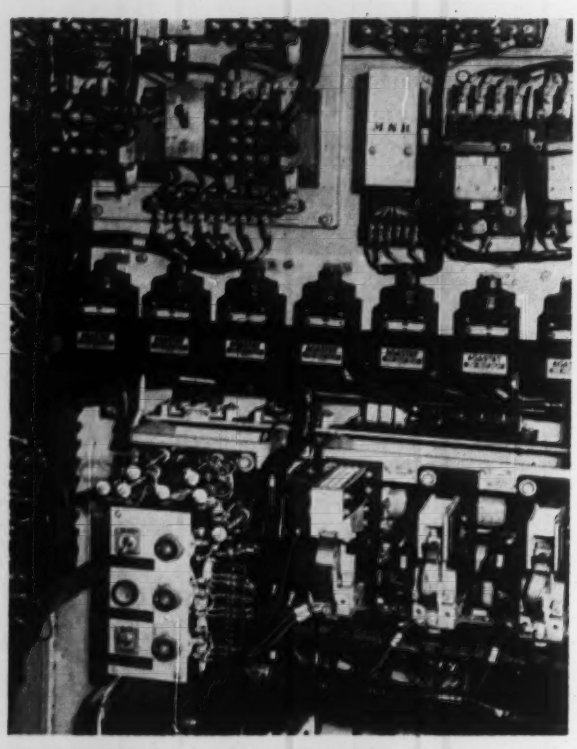


Fig. 6 Turbine control devices for a Union Pacific gas-turbine electric locomotive. Several failures resulted from trouble with relays and other regulators.

hose used as a flexible connection between locomotive piping and turbine-fuel pump. The hose carries diesel fuel used as fuel-pump-control oil. Age of the hose could not be determined.

On August 1, Locomotive 59 lost 30 min running time between Sidney and Cheyenne due to low turbine power. Investigation developed a cracked bellows in a pneumatic temperature-control device giving false indication of excessive temperature. The failure of the bellows was due to fatigue caused by vibration.

On August 24, Locomotive 61 experienced a similar failure. Temporary repairs were made by bypassing the pneumatic relay involved without loss of temperature control. This raises doubts as to whether the device is necessary.

On August 10, Locomotive 65 was removed from a train departing from Cheyenne because the turbine quit firing. Investigation developed that failure was caused by movement of a plastic-insert-type lock nut which loosened from vibration.

On August 29, Locomotive 65, turbine died at Hermosa resulting in a 1-hr 5-min delay. Inspection failed to develop a reason for the failure.

On August 24, Locomotive 67, turbine would not fire at Ogden. Investigation developed that both high-voltage-ignition-plug leads had failed.

On August 8, Locomotive 69 delayed 1 hr 30 min leaving Rawlins. Investigation disclosed that a pneumatic-type time-delay relay, Fig. 6, used in the cranking cycle failed to function. This prevented completion of cranking.

On August 12, Locomotive 69, turbine quit firing. Investigation finally developed that erratic operation of the fuel regulator was responsible.

On August 6, Locomotive 70 was held to change a failed atomizing air compressor. Investigation developed that failure was caused by excessive turbine vibration. After the turbine was disassembled, source of the vibration was traced to a manufacturing error. A short turbine-rotor shaft at the No. 3 bearing resulted in a short interference fit at the spline hub. The short fit wore excessively after 1989 hr.

On August 12, Locomotive 73, turbine died west of Laramie. The train was delayed 2 hr 30 min with three other trains held up from 30 min to 1 hr while obtaining a replacement locomotive. The trouble was found in the fuel regulator, which had jammed and stripped gears in the drive mechanism.

On August 12, Locomotive 75, turbine quit firing departing from Cheyenne. Defect was traced to air leakage from wire-reinforced hoses used in connections to turbine-temperature control panel. Hose had become porous due to baking from external heat in the vicinity. This was another case of poor material selection.

Conclusions

While it is indeed true that railroad inspection and maintenance practices are not overly elaborate, the majority of failures detailed above must be charged to the fact that control devices and auxiliary equipment designed primarily for stationary service usually lack the ruggedness and simplicity needed for railroad service.

In the trend toward automatic operation there is a tendency on the part of control designers to make control systems overly complicated. There is also a tendency to overcome faults in control devices by the addition of another device rather than correcting the basic fault.

To date, the Union Pacific has not accumulated sufficient gas-turbine experience to assign an estimated life to turbine components. During this development period there have been so many modifications that life data on most components are very clouded. There have been some spectacular improvements in individual items such as fuel nozzles and combustion chambers, but it is still too early to tell where developments will lead.

The foregoing detailed analysis might leave the impression that gas turbines are too unreliable for locomotive power plants. A brief look at the performance record shows that the opposite is true. During the same month of August the active fleet of turbine locomotives averaged 12,026 miles, which was considerably better than any other type of freight locomotive assigned to the same district. The turbines handled 18.2 per cent of the freight hauled on the Eastern District and 11.5 per cent of the freight on the entire system. Records show that the turbine failures detailed here occurred at a rate of only 8.7 per 100,000 miles, which is not a bad record. These locomotives consistently move trains faster than other types of freight power, with the August average being 34.95 train miles per train hr. This is 6 mph faster than comparable diesel-electric units. This performance is very attractive to the Union Pacific in its constant effort to speed up freight movement. While failures cannot be ignored, they can be endured during the development of a power plant which excels in performance.

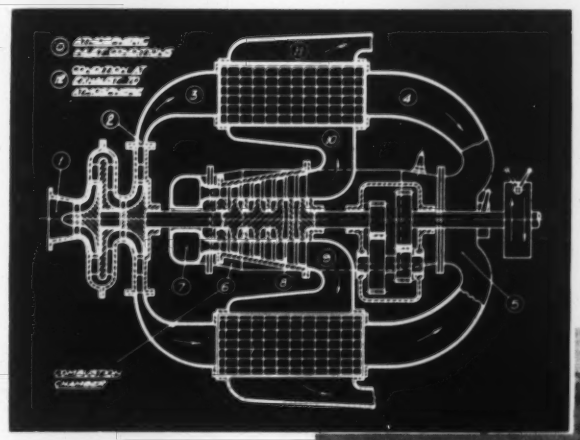


Fig. 1 General arrangement of the Austin gas turbine

Fig. 2 The Austin gas turbine was tested in a production-model body, the 1950 Sheerline which is normally powered by a 120-hp piston engine

Gas-Turbine Automobiles[1]

High-specific power, extended life from the lack of piston friction, and the absence of the vibrational forces which accompany reciprocating action, low lubricating-oil consumption, and no cooling water, are advantages cited for these vehicles

THE gas turbine is currently being applied to both nuclear and conventional power generation, and air and rail transportation. Several automobile manufacturers are experimenting with road vehicle applications. The essentials of two development programs abroad for automotive application are condensed here. Further details are available in the original papers.

Austin Gas Turbine[2]

IN 1949 the Austin Motor Company decided to investigate the possibilities of gas turbines for automobile and small industrial usage, although there is still plenty of potential development left in the conventional piston engine in the direction of increased compression ratios and reduced friction losses. The larger and more expensive passenger vehicle was chosen for development since gas-turbine costs do not come down pro rata with horsepower.

[1] Based on two papers contributed by the Gas Turbine Power Division and presented at the Gas Turbine Power Conference, Detroit, Mich., March 18–21, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

[2] "The Austin Vehicle Gas Turbine," by J. H. Weaving, chief research engineer, Austin Motor Company, Longbridge, Birmingham, England. Condensed from ASME Paper No. 57—GTP-2.

Design

The main factors that influenced the design were: (*a*) That it should incorporate all the components ultimately necessary to give an engine which would have a fuel consumption competitive with the piston counterpart; (*b*) that it could, with manufacturing development, be produced at an economical price; and (*c*) that it would be safe and reliable.

From the price considerations an axial compressor was rejected and, in order to provide a reasonable pressure ratio of 4:1 or a little over, a two-stage centrifugal compressor was chosen. The general arrangement is shown diagrammatically in Fig. 1. A legend of the various stations referred to in this paper is designated by numbers 0 to 12 on this diagram. With a two-stage compressor, rotational speeds and stresses can be kept down and, in addition, there is the possibility of higher cycle temperatures than would be desirable with a single stage.

A three-stage axial turbine was used to drive the compressor, being followed by a single-stage axial-power turbine. Although having twice as many turbine wheels as absolutely necessary, design made it possible to use the same blade section throughout, and stresses were kept at reasonable values. Consequently, a simple pin fixing

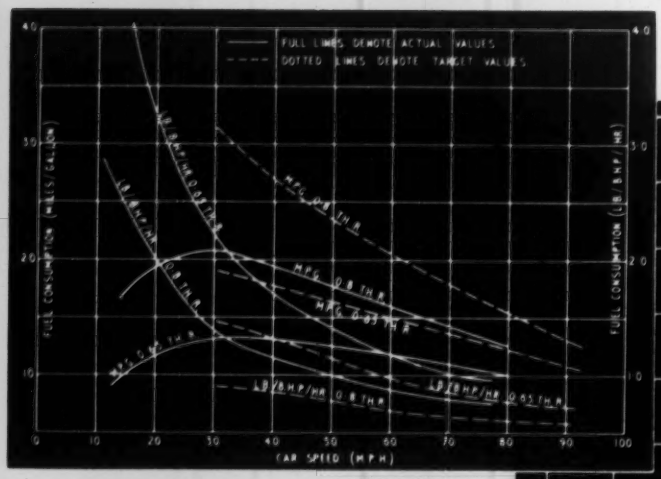

FULL LINES DENOTE ACTUAL VALUES
DOTTED LINES DENOTE TARGET VALUES
FULL CONSUMPTION (IMPS GALLONS)
FULL CONSUMPTION (LB. B.H.P./HR)
CAR SPEED (M.P.H.)

Fig. 3 Austin road-load fuel consumption—actual and target, in imperial gallons

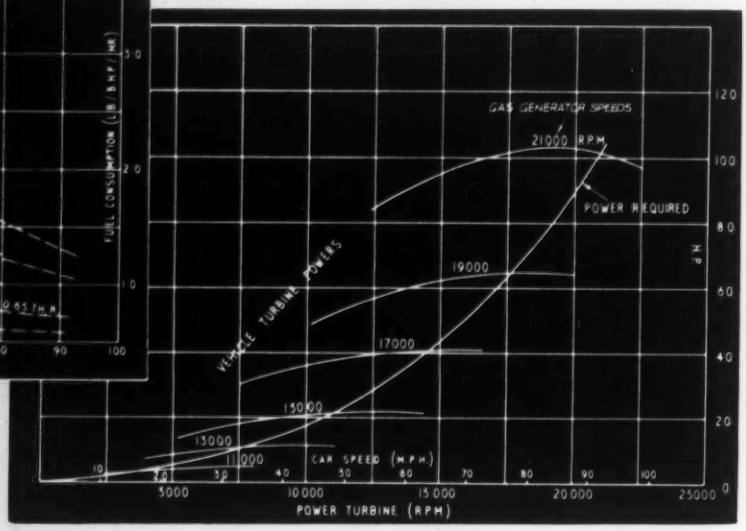


Fig. 4 An actual road-load performance for the Austin gas-turbine engine

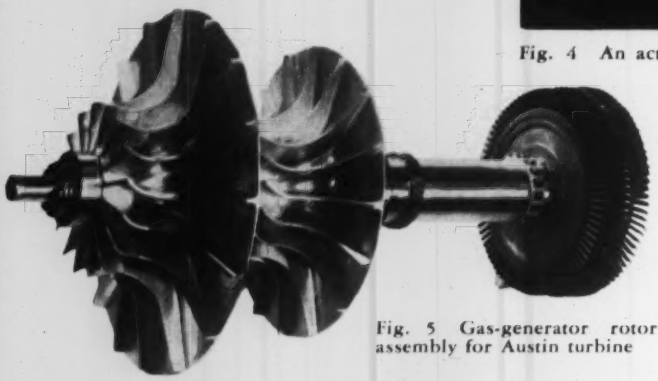


Fig. 5 Gas-generator rotor assembly for Austin turbine

for the separate blades was used, as can be seen in Fig. 5 which shows the gas-generator rotor complete.

It was realized that even with the higher pressure ratios possible with two stages, a heat exchanger would still be essential for part loads and also advantageous for full-load conditions.

However, it was a difficult problem to decide the best type of heat exchanger for the vehicle application. The rotary regenerator is very attractive, particularly in theory, as the weight and size of the matrix compares favorably with that of the static or recuperative type. But, leakage from the high-pressure air side to the exhaust must be kept low or the advantages are mainly lost. This sealing has to be accomplished in the face of an adverse temperature condition and there is the further complication of providing a suitable drive of low speed. Although by no means rejecting the concept of the regenerator, because of these difficulties it was decided that the recuperator was the better proposition for initial work.

Considering the recuperator, with a contraflow type there is no actual limitation to the thermal ratio attainable, but in a passenger vehicle, space and weight limitations preclude anything much above 0.8 thermal ratio at full load, and for the same reasons about a 4 per cent total pressure drop for air and exhaust sides together must be accepted. Calculation shows that with an unmixed cross-flow heat exchanger the economic limit of thermal ratio is considered to be about 0.65, but this type has the advantage of much simplified end connections and ducting arrangements, and for these reasons it was decided to use a cross-flow heat exchanger on the first experimental engine. We consider it should show up all the major problems, although we realize that we should not get the fuel consumptions which ultimately would be necessary. In actual construction, two heat-exchanger blocks were situated on the sides of the turbine in pannier fashion, the matrix being a secondary surface type made up of corrugated sheets and spacers. These were manufactured to our design by Marston Excelsior, Ltd., Wolverhampton, who developed the technique of manufacture.

For combustion a single chamber with spill-type atomizer was developed by Joseph Lucas Ltd., and this was mounted over the top of the unit.

Auxiliaries are driven from the compressor shaft at the rear of the compressor and there is a two-stage helical spur-gear reduction box from the power turbine feeding into a reversing gear box of the planetary type which was designed and made by Hobbs Transmission Ltd.

This turbine unit was designed for 120 bhp with an air-mass flow of approximately 3 lb per sec.

Present results show that we still have a long way to go to supersede the piston engine from a point of view of fuel consumption. However, target calculations show that equality in this direction should be obtainable with reasonable development. Even with the increased compressor and turbine-component efficiencies so desirable, a heat exchanger of at least 0.8 thermal ratio will be required.

The other well-known limitation of the turbine vehicle is the delay in acceleration from rest while the gas-generator portion of the unit is speeding up. But to offset these present shortcomings are many advantages which have been enumerated by other authors. The most important of these we consider to be high specific power, long life due to no rubbing parts like pistons, absence of large vibrational forces due to reciprocating

parts which even in a balanced crank configuration require heavy internal construction, low lubricating-oil consumption, and no cooling water. In view of these substantial advantages we feel that the turbine has an optimistic future, even for vehicles, which bitter experience has shown us to be the most difficult of applications, owing to the wide range of speeds and loads.

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Fiat Gas Turbine[3]

FIAT began development of a gas-turbine engine in 1948. Because specialists in this field in Italy were few and needed for aeronautical work, engineers with general automotive background were assigned, and conservative initial design data were chosen. A power rating of 200 hp was selected for the first engine, designated Type 8001.

Design

A gas-turbine cycle without heat recovery was selected because of the bulk of a conventional heat exchanger and the uncertainty of the development of a rotating heat exchanger. A high-pressure ratio was used in an effort to minimize specific fuel consumption. Finally, the torque requirements were realized by use of a two-shaft arrangement with a free-power turbine.

[3] "Development of Gas Turbines for Road Vehicles," by A. Carelli, assistant staff engineer, Dipartimento Sviluppi e Ricerche, Corso G. Agnelli, 200, Torino, Italy. Condensed from ASME Paper No. 57-GTP-3.

The necessity of installing the engine in an automobile as well as the geometrical characteristics influenced the engine structure. The problem of installation was examined simultaneously with the first engine plans. After analyzing several solutions, the rear-mounted arrangement was chosen.

Engine dimensions were established on the basis of data from service-proved turbines as well as of results from computations. It was, in fact, during this stage that the conservative design figures were taken as a basis. Consequently, during the development stage it was possible to increase appreciably the initial design power rating by exploiting the working potentials of major parts.

A long series of engine-part laboratory tests was run in parallel with the theoretical development. Thus when the design reached the final stage many components were already far advanced.

Now, after four years of tests—in the laboratory and on the car—the appearance of the engine structure is as illustrated in Fig. 6 and as shown schematically in Fig. 7.

A two-stage gas-generator compressor and turbine were adopted by Fiat to make the 7 to 1 pressure ratio possible. This ratio corresponds to the minimum fuel consumption obtainable at a combustion temperature of 800 C. Location of the compressor has been inverted to shorten the engine and this is why the air intake is in a central position.

Because of using a two-stage compressor the high-speed shaft is long. It is therefore divided with one shaft for the compressor, Fig. 9, and one for the turbine, Fig. 10. Each is carried by a ball bearing and a plain bearing and they are connected by splined sleeves. The same divided-shaft arrangement was adopted for the power-turbine shaft which is coaxial with the hollow gas-generator shaft, being mounted in its bore. The main reduction gear incorporates a two-speed gear changer which, however, cannot be used when the engine is running. Its purpose is to permit car-performance tests

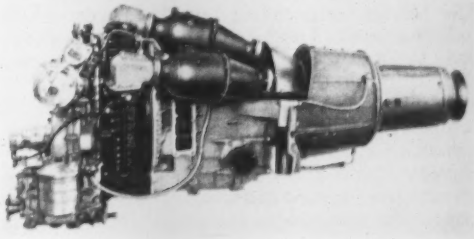

Fig. 6 External view of the Fiat 8001 gas turbine

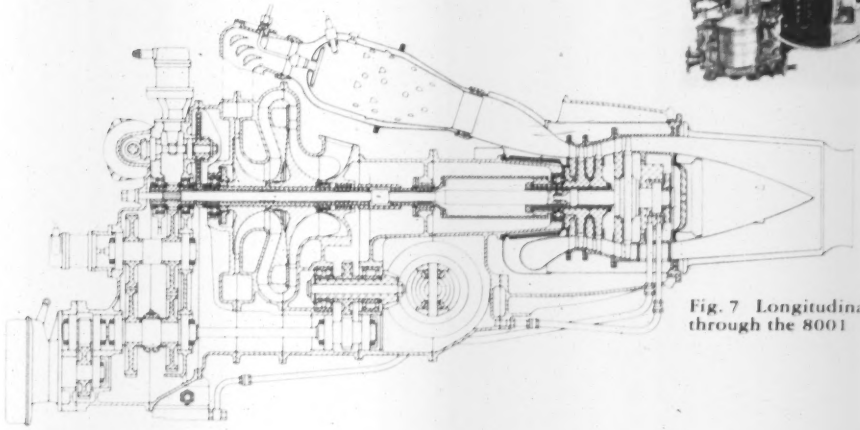

Fig. 7 Longitudinal section through the 8001

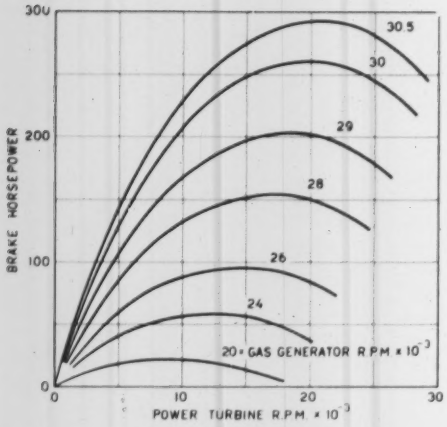

Fig. 8 Power output of the 8001 gas turbine

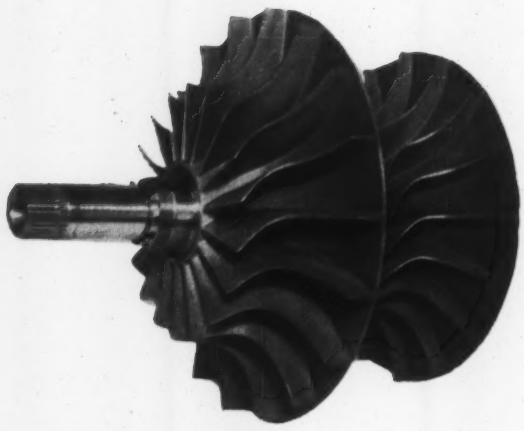

Fig. 9 Two-stage compressor rotor for the Fiat 8001

with two different gear speeds without having to disassemble the engine. Along with the car differential unit the engine incorporates a hand brake which is replaced by a power take-off during rig tests.

There are three straight-flow combustion chambers, each equipped with a simple swirl atomizer injecting downstream. The single surface-discharge spark plug is located in the central chamber. Ignition for the two side chambers is obtained through small interconnecting ducts. The fuel system includes the atomizers, a booster pump, filter, plunger-type injection pump, and a throttle.

The lubrication system is composed of a gear-type delivery and two gear-type scavenge pumps. The system is divided into two sections—a high-pressure primary circuit and a low-pressure secondary circuit. In the primary circuit, pressure is governed by a conventional pressure-relief valve, while in the secondary, this task is accomplished by a pressure-reducer valve drawing oil from the primary circuit. The high-pressure circuit feeds all plain bearings and the sprays for main gear lubrication. The low-pressure circuit lubricates only the high-speed ball bearings. The oil filter is of the full-flow type. A conventional truck-type starter motor is used for starting.

Problems developed from two fundamental causes: high temperature and high speed. In the 8001 turbine, and generally in small turbines, undesirable heat transfer is increased by the low Reynolds numbers and by the relatively wider wetted surfaces. The small dimensions also reduce the comparable amount of cooling fluids that can be brought to hot areas. The result of these factors is a noticeable temperature rise throughout the engine.

The use of an Mg-Zr alloy in place of an aluminum one for the compressor housings improved the heat-resistant properties of the compressor housings.

The turbine housing was modified to provide better support and permit free symmetrical expansion to eliminate rubbing in the turbines and sagging under extreme heat.

Oil cooling was provided to extend the operating temperature limits of the bearings. To obtain satisfactory performance of the gas-generator bearings at high speeds, the cages were made of forged brass, the wearing surfaces were silver plated, and the cages redesigned to ride on the outer races.

Engine Operation

The design of a governor that would control all possible engine characteristics would be too complex, and at present the engine is controlled by a throttle valve. Acceleration is controlled by the driver who observes the indication of temperature upstream from the turbine and regulates the accelerator accordingly. He also observes an rpm indicator for possible engine overspeed.

Engine Starting. To start the engine it is necessary to first bring the throttle to idle position and then close the engine electrical circuit. This energizes both the spark plug and the starter solenoid. The starter solenoid engages the clutch and at the same time closes the main starter circuit. The starter accelerates the gas generator to about 5000 rpm at which speed fuel is ignited by the spark plug. With the aid of combustion gases, the starter accelerates the gas generator to about 10,000 rpm at which point the engine is self-sustaining. The driver now releases the starter button deenergizing the electrical circuit. The entire starting cycle takes about 15 sec.

Acceleration. In automotive applications, besides steady-load performance, acceleration characteristics also are very important. The most significant index from this viewpoint is the time required to bring the gas generator from idle to full load. This time is minimum when the largest amount of fuel is fed without exceeding the highest allowable temperature on turbines. This temperature, being a transient temperature, may differ from that corresponding to steady full load.

Future Developments

The development of present road vehicles has been affected deeply by the reciprocating-engine characteristics. If this type of engine were replaced by the gas turbine, the entire vehicle layout should be revised because the characteristics of the two engines are quite different. For this reason, to evaluate the chance of success of the gas turbine in the automotive field, a comparison between the two types of engine would be inconclusive. The comparison must be extended to the whole vehicles they would drive. In other words, the success of gas turbines depends upon the possibility of equaling or even improving with a gas-turbine vehicle the performance and

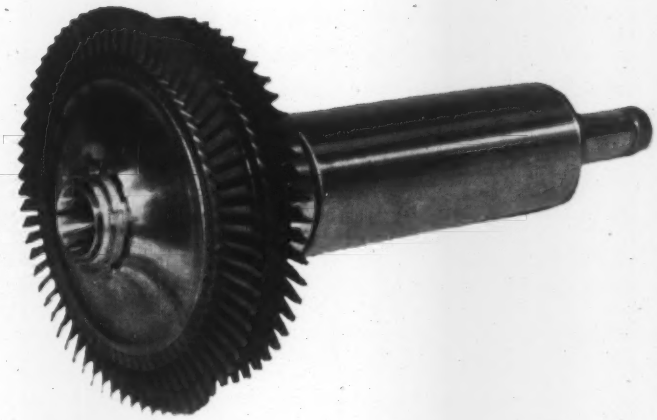

Fig. 10 Two-stage turbine rotor for the Fiat 8001 gas turbine

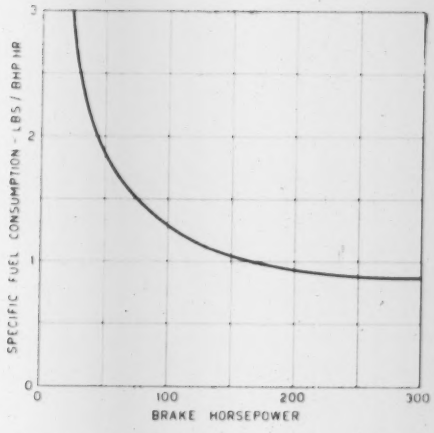

Fig. 11 Specific fuel consumption of the Fiat

costs of the reciprocating-engine vehicle. Main performance data to be considered are: useful load; maximum speed; driving, acceleration, and braking characteristics; servicing and overhauling requirements. The costs to be considered are those of vehicle (engine included), fuel oil, and spare parts. Some of these factors have been investigated already, but for many of them the available data are very scanty. Under this condition it is impossible to reach reliable conclusions and any anticipation would have little or no meaning. The discussion is therefore restricted to some considerations on the main problems that must be solved before the gas turbine may successfully replace the reciprocating engine in road vehicles.

Choice of the Gas-Turbine Cycle. If it were possible to reduce the weight of the vehicle power plant, the total weight of the unloaded vehicle also could be decreased. Then the payload of trucks could be increased and the larger income would pay for an incidental higher specific fuel consumption of the engine. For cars, with the same passengers, the lighter engine would lower the total vehicle weight. This weight directly affects the power required by acceleration, climb and, to a lesser extent, speed; therefore the engine rated power could be lowered and a higher specific fuel consumption could be allowed without changing the total consumption.

These considerations must be kept in mind when choosing the gas-turbine cycle for automotive applications. So far, the cycles used are of the simple and regenerative type. All other cycles with intercooling or reheating have been discarded being too complex. The most important difference between simple-cycle and regenerative-cycle engines is in the weight, which is lower in the former type, and in the specific fuel consumption which is lower in the latter. Therefore it is very difficult to say which of the two types would be more suitable for vehicle propulsion.

Layout and Constructional Problems. In addition to the chosen cycle, also propulsion requirements and performance of each element will influence the engine layout. All present automotive gas turbines, for propulsion requirements, are of the two-shaft type with free-power turbine and it is likely that they will continue to be so in the future. Better performance justifies the general use of centrifugal compressor and axial-flow turbines.

Accessories. In present road vehicles, accessory units operate at speeds of the same order of those of the reciprocating engines on which they are fitted. The same should happen for accessories used with the gas turbines of high rotational speeds. If it were possible to increase operating speed of starters, generators, fuel, and oil pumps, the auxiliary reduction gear would be simpler and the units would be smaller and lighter. Progress in this direction is limited by cavitation in pumps and brush wear in electrical machines.

Other Problems. The success of the automotive gas turbine will depend also on the solution of the power-transmission problem. This problem is connected with chassis design and therefore is outside the scope of this paper.

Conclusions

Results hitherto obtained with the 8001 automotive gas turbine justify the pursuit of the development work. Though fairly good, present performance can be improved both in output and in specific fuel consumption. The engine, on account of its excessive power and perhaps also of the thermal cycle, will certainly not be the likely substitute of the reciprocating engine in automotive application.

If applied to automotive traction, gas turbines will involve new solutions both in chassis and body. These solutions have yet to be investigated in detail and therefore it is impossible to anticipate whether the new type of engine will replace the reciprocating engine. Assuming this will happen, the substitution will be earlier and more extensive in the United States where passenger car average power ratings exceed 200 hp, rather than in Europe where the average power hardly reaches 60 hp. Because of the difficulties involved in developing a gas turbine with such a low power output, in Europe—at least initially—applications will be limited to larger or sports cars requiring over 100 hp.

The advent of the gas turbine on commercial, industrial, and military vehicles is favored by the higher power ratings both in the United States and in Europe; as a truck power plant it is adversely affected by the more stringent economical and life requirements of the commercial transportation field.

Increasing responsibility for management, a wide variety of interests and specialties, broad education in the engineering sciences, and the ability to communicate are some of the . . .

As many of you are aware, there is in existence a joint Technical Committee of the Engineers' Council for Professional Development and the Engineers Joint Council, chaired by Morris D. Hooven, which has submitted a proposal for an extremely broad and searching survey of the entire engineering profession to be undertaken in the near future. Among the hundreds of questions to be answered by such a survey would be:

- What is an engineer?
- What areas of activity constitute engineering?
- What are the legitimate major branches of engineering?
- Are there different levels of engineering, and if so, how may one be delineated from the other?

Thorndike Saville in his president's report to ECPD this year has said: "This proposal constitutes the greatest challenge which has ever confronted the engineering profession. . . . It will require the best leadership of which the profession is capable, assisted by a few outstanding citizens from other walks of life who are objectively concerned about the role of engineering in technological civilization. It will require imaginative organization and conduct, and, based upon recent surveys with somewhat similar objectives by other less complex professions, it will continue for two or three years, and may cost upward of a million dollars."

Any statements regarding "The Distinguishing Characteristics of Mechanical Engineers" may quite possibly be proved wrong by such a survey, nevertheless the topic will be discussed with confidence that there will be no lasting ill effect in view of this.

What Is Meant by the Term "Engineering"?

In any discussion it is rather hard to determine just what is meant by the term "engineering." Do we mean a designation of an educational program, a profession, an attitude of mind, a function, or a process?

The educational process of producing an engineer has two objectives, according to the ASEE Report on the Evaluation of Engineering Education. The first objective, the technical goal of engineering education, is preparation for the performance of the functions of analysis and creative design, or of the functions of construction, production, or operation, where a full knowledge of the analysis and design of the structure, machine, or process is essential. It also involves mastery of the fundamental scientific principles associated with any branch of engineering, including a knowledge of their limitations and of their applications to particular problems, such as the development of materials, machines, or structures as well as the ability to make critical scientific and economic analyses, and to organize these into clear, concise, and convincing oral or written reports.

The second objective, the broad social goal of engineering education, includes the development of leadership, the inculcation of a deep sense of professional ethics, and the general education of the individual. These broad objectives include an understanding of the evolution of society and of the impact of technology on it; an acquaintance with, and appreciation of the heritage of, other cultural fields; and the development of both a personal philosophy which will insure satisfaction in the pursuit of a productive life and a sense of moral and ethical values consistent with the career of a professional engineer.

Definitions of engineering as a profession or a function are constantly being given, revised, and restated. Perhaps the most thought of which a large number of people has been devoted to is the definition suggested by a subcommittee of the Recognition Committee of ECPD.

The Committee's suggested definition is as follows:

"Engineering is the profession in which a knowledge of the mathematical and physical sciences gained by study, experience, and practice is applied with judgment to develop ways to utilize, economically, the materials and forces of nature for the progressive well-being of mankind."

What or Who Is an Engineer?

The variation arising when we ask the question "What or Who is an Engineer?" is often a matter of attitude or of opinion. The graduate of an engineering college is very likely to define an engineer as one who graduates from an engineering college. Nonengineers are prone to think of an individual in command of a steam locomotive, or someone who likes tinkering with engines and machinery. It has been stated that many of the mechanics who tinkered with and ran the early mine-shaft and canal-lock machinery in England merely put on white shirts to become mechanical engineers. Unfortunately, a great many high-school students and their counselors still have this picture, judging from the high-school backgrounds and interest patterns of some of the young men attempting to enter engineering colleges. Then there is the version of the PhD in mathematics, physics, or chemistry who thinks of the engineer as a sort of watered-down scientist who puts into use the things the scientist learned long ago. This springs from the fact that many scientists have less of a conception of engineering than engineers have of science.

An impersonal concept of engineers often develops among employers who regard them as groups of brains or talent rather than as individuals.

Distinguishing Characteristics of Mechanical Engineers

In attempting to identify some of the distinguishing characteristics of a mechanical engineer, we might look first at the preparation received in undergraduate curricula.

The American Society for Engineering Education in the report of its committee on the Evaluation of Engineering Education suggests that engineering science stems from two basic areas: mechanical phenomena of solids,

Condensed from a paper contributed by the Education Committee and presented at the Annual Meeting, New York, N. Y., Nov. 25-30, 1956, of The American Society of Mechanical Engineers.

...Distinguishing characteristics of mechanical engineers

By Guy R. Cowing, Mem. ASME

President and Director, General Motors Institute, Flint, Mich.

liquids, and gases; and electrical phenomena. It says that a common practice is to subdivide these into the following six engineering sciences:

1 Mechanics of solids (statics, dynamics, and strength of materials).
2 Fluid mechanics.
3 Thermodynamics.
4 Transfer and rate mechanisms (heat, mass, and momentum transfer).
5 Electrical theory (fields, circuits, and electronics).
6 Nature and properties of materials (relating particle and aggregate structure to properties).

Few existing curricula contain all six despite wide agreement as to their basic desirability. However, it is significant that mechanical-engineering curricula have usually included more of these than other engineering curricula. Perhaps, then, one of the distinguishing characteristics of the mechanical-engineering graduate is breadth of foundation in the engineering sciences.

The advantages of such breadth of preparation were admirably expressed by Alfred P. Sloan, Jr., when he received the Hoover Medal in October, 1954.

"Almost every schoolboy knows that our contemporary civilization is basically a technological culture. The relatively high level of wealth and productivity of the twentieth century is constantly expanding personal income. The century's unprecedented and continually advancing standard of living is a phenomenon almost wholly dependent on technology. Our wealth, production, and standard of living are primarily the product of the engineer. It is he who has capitalized the fundamental knowledge flowing from basic research, supplemented that knowledge with his own experience, and transformed it most effectively into better ways of doing and living. It may be said that the engineer typifies the twentieth century. He is particularly representative of its culture. Without his genius and the vast contribution he has made in design, engineering, and production, on the material side of our existence, our contemporary life could never have reached its present standards.

"Perhaps the public's lack of understanding of the engineer's expanded activity lies in the fact that it is only recently that he has entered broadly into the area of directing and managing the civilization to which he has contributed so much. Perhaps it is because, after all, he is himself largely a product of the twentieth century. As a matter of fact, it is only within the past generation or so that there has been a broad tendency on the part of the engineering profession to move out of its technical boundaries and assume responsibilities in the management, direction, and leadership of our economic, social, and national affairs.

"Such an evolution in the responsibilities of the engineering profession is both logical and desirable. Certainly it is a proper assumption that he who has done so much to create our culture must have the necessary competence to guide and direct it; and it is appropriate that he should have the opportunity to do so in a major way. But there are other substantial reasons why the engineer should play a large part in the direction of our society.

In the first place, we need the engineering point of view. Now, more than ever. And in the future, vastly more so than now. In the organization and direction of large-scale enterprises, economic or social, we need the respect that the engineer has for basic facts. We need his analytical frame of mind. We need his imagination. We need his contact with interpretation and control of the physical forces. Such is the type of discipline, as I see it, that is sure to contribute to a maximum degree of order and sense in our complicated economy and promote the best and most efficient use of our national resources, both human and material."

Engineers in Management

Some years ago the American Institute of Management, from a study of more than 2000 companies, selected 238 as being excellently managed, and then analyzed the background training of the presidents of 159 of these companies. The companies had an aggregate sales volume of nearly $50 billion, and were scattered throughout 74 different industries. Engineers were found to outnumber all other professional people as presidents of these representative corporations.

Thirty-three per cent of these men had come up to the presidency by the engineering route. Most of these were mechanical engineers, but there was also a liberal representation of civil, electrical, chemical, and mining engineers. Interestingly, the proportion of engineers serving as presidents or chairmen of the board has greatly increased in recent years; a few years ago it was only 20 per cent.

At one time within the past few years, five of our great industrial enterprises simultaneously had engineers serving as their chief executives. These were the presidents of Bethlehem Steel, United States Steel, and General Motors; and the chairmen of the boards of Standard Oil of New Jersey, and the General Electric Company.

Perhaps, then, a second characteristic of the mechanical engineer is the readiness with which industry accepts him for a wide variety of assignments.

In General Motors, mechanical engineers perform an extremely wide variety of tasks from the top management of a manufacturing plant to the design of an assembly fixture for sealed-beam headlights. He may be found working with spark plugs, radiators, bombsights, automatic pilots, ball bearings, gas turbines, hydraulic transmissions, shock absorbers, diesel engines, 2-cycle marine gas engines, refrigerators, dehumidifiers, radiator caps, automotive clocks, domestic oil furnaces, electric motors, deep-well pumps, clothes dryers, automobile bodies, automotive radios, automatic washing machines, voltage regulators, air cleaners, fuel pumps, Greyhound buses, diesel locomotives, turn signals, or powdered metal bearings—to mention only a few.

He may be designing the product itself; inventing new products; testing the product, its components, and the materials in it; analyzing its performance and making a mathematical analysis of stresses encountered.

He may be engaged in development of the new product, getting it reduced to drawings and specifications, and in getting it "engineered" for production.

He may be concerning himself with the development of a new production process, or the adaptation of a current process to a new product.

He may be utilizing all of his engineering know-how in determining the best processes and equipment for the mass production of high-quality products.

He may be responsible for the development of a new "in-line" machine which will replace 32 operators on 38 different machines.

He may be the project engineer in charge of the design, installation, and "debugging" of a highly automatic conveyer system for handling 78 different kinds of parts between various assembly stations.

He may be working on the tremendously intricate task of designing and developing tools, dies, jigs, assembly fixtures, welding fixtures, and gaging fixtures for the production of an automotive body.

Variety of Interests of Mechanical Engineers

In my opinion, the mechanical engineer professionally is also characterized by the variety of his interests and specialties. For example, ASME recognizes 23 different professional divisions ranging from Aviation to Wood Industries, and from Oil and Gas Power to Nuclear Engineering. A look at the program of the 1956 Annual Meeting of the Society indicates again the wide interests and accomplishments of the mechanical engineer.

Where else but in this Society can you find men with such widely divergent interests in such topics as:

"The Design and Operation of an Electrical Analog of a Reciprocating Compressor Installation"

"First-Line Supervisors—How Do They Spend Their Time?"

"Fatigue of Metals Under Combination of Stresses"

"Push-Button Carloading in a Palletized Brewery"

"The Utilization of Solar Energy"

"The Collapse Strength of Redundant Beams After Lateral Buckling"

"The Effect of Heavy Rainstorms on J-47 Turbo-Jet Operation"

"Boiler Vibration Caused by Combustion Gas Flow"

"A New Chlorine-Containing Polyether"

"Space Law and Sociology" (American Rocket Society)

"Progress Report on the Continuous Dyeing of Tufted Carpets"

Perhaps no other branch of engineering is broader in its scope. In my opinion, because of the breadth of the preparation received in the usual curriculum and the variety of not only his activities but his interests, the mechanical engineer seems to have a great awareness of the basic requirements of the other branches of engineering, and as a result he is able to co-operate with other engineers and has an abundance of "horse sense" measured in terms of his ability to communicate with them.

Because of this awareness and grasp in other fields and the resultant ability to communicate with others, the mechanical engineer frequently finds himself supervising others and becomes the "engineer in charge," the "project engineer," or the "administrative or executive engineer."

Since a great many times he is vitally interested in fabrication and manufacturing and cost thereof, he has a basis for understanding the problems and viewpoint of the administrator or manager, and as a result often finds himself in these positions.

This understanding of other fields on the part of the mechanical engineer springs from the fact that he concerns himself

- more with dynamics than statics
- more with kinetic energy than potential energy
- more with the locomotive than the roadbed
- more with the automobile, truck, and bus than the street, road, or superhighway
- more with the airplane than the airport

This means that he is interested in movement, mechanics, and mechanisms which in some ways are associated very closely with implementation, experimentation, "tinkering," and making—the fields of the technician and the craftsman. The mechanical engineer has therefore particular aptitude in communicating with these two vocations, both of which are essential to the ultimate success of any engineering project.

It is certainly true that tremendous advances in science and technology are just ahead. No one of us can imagine the extent to which new developments may affect our mode of transportation, our use of leisure time, our educational methods, our health, and even our eating habits in the next 25 years.

In spite of the fact that I may be accused of thinking that the mechanical engineer will contribute a major part to the advances of tomorrow, I still suggest that the mechanical engineer can be characterized by

1 The breadth of his education in engineering sciences.
2 The wide variety of his interests.
3 His ready acceptance by industry for a great variety of assignments.
4 His awareness of the requirements of other branches.
5 His ability to communicate with other engineers as well as with management, technicians, and craftsmen.

Developments in the peaceful application of atomic energy, in the replacement of the vacuum tube by the transistor, the extension of ultrasonics to cleaning and to production applications such as making intricately shaped holes, developments in the use of solar energy, new types of internal-combustion engines, new methods of producing light, and automation within industry—to mention only a few—offer tremendous challenges to the mechanical engineer.

Notes on Catalytic-Cracked Fuels

By E. H. Weston, Mem. ASME

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IT IS AN OLD economic axiom that supply inevitably will equate itself with demand.

Up to a few years ago, straight distillation of a cut of Gulf and East Coast crude petroleum gave about 25 per cent gasoline and 28 per cent kerosene and light distillate.[1] As long as a 25 per cent yield of gasoline and a 28 per cent yield of kerosene and light-distillate fuel would cover current market demand without a glut of heavy distillate and residuals resulting from the straight-distillation process, the supply-and-demand picture was nicely balanced. But automobile registrations were on the increase and the users of residual fuel oil—notably steam locomotives—were on the decrease. The nice material balance was upset, and more gasoline and less residual fuel from the same gallon of crude petroleum had to be obtained. The catalytic-cracking plant needs the light and heavy straight-distillation products to do its job and can augment the percentage of gasoline obtained from straight distillation by as much as 26 per cent—approximately doubling the previous yield. Now, some 51 per cent of a gallon of crude petroleum can be converted to gasoline by straight distillation and catalytic cracking. About 9 per cent of the yield from crude petroleum ends up as light distillate fuel using the "cat" cracker—heavy distillate fuels having largely disappeared.

It is the output of the catalytic-cracking plant that is now making its presence felt as diesel fuel on the railroads. How important is this cat-cracked diesel fuel likely to become?

Domestic Liquid-Fuel Supply

According to one estimate based on testimony before a Congressional Committee,[2] domestic production of petroleum will decline after 1957 or 1958 when a 3 billion bbl per yr max is reached, dropping to 1.5 billion bbl per yr in 1965. At the same time, demand will climb steadily to almost 4 billion bbl per yr in 1965. The gap between mounting domestic demand and declining domestic production must be met either by synthetics made here at home from oil shale and/or tar sands or imports.

As imports and synthetics make their appearance in the American petroleum picture, prices per gallon of finished product will mount. The revised price structure will heighten the efforts of the oil companies to satisfy the user willing to pay the highest price. The railroads are not going to be among those users willing to pay a competitively escalated price of diesel fuel without a struggle. Fuel costs today are a major part of transportation expense, but in an ascending price scale they will become even more important in the transportation cost ratio.

To meet the domestic demand for jet fuel and gasoline using expensive imported crude and domestic synthetics, the oil companies will tax their catalytic-cracking process to the maximum. While we are now burning blends of straight-run and cat-cracked diesel fuel in our diesel locomotives, very shortly we can look to fuels made up of 100 per cent cracked and recycled stock.

Characteristics of Cat-Cracked Fuel

Cat-cracked fuel is heavier in weight than straight-run distillate fuel, has a lower flash point, a lower pour point, and a lower initial boiling point. It might be concluded that cat-cracked fuel has more volatile "lower ends," and that it will start burning at a lower temperature, and lower pressure in the engine. There is a greater range between the lower volatile and heavier upper ends as seen in the distillation characteristic of the cat-cracked fuel—298 F as compared with 238 F for the straight-run distillate.

The increased distillation range suggests a wider range of internal cylinder conditions to promote complete combustion. A wider range of internal cylinder conditions suggests a greater time period needed for burning.

Little is actually known about the combustion process in a diesel engine. Most engine manufacturers will admit that the injection timing and valve timing used on their engines are a compromise for as wide a range of distillate fuels as possible. The actual injection and valve timing selected are based on laboratory tests involving many different types of fuels; the engine itself selecting its own fuel range and timing to produce maximum horsepower.

In order to increase horsepower output, the engines are balanced on a narrow air-fuel-ratio pinpoint, allowing little latitude for fuel specification. Cat-cracked fuels have different carbon-hydrogen ratios and molecular weights than those associated with straight-run distillate fuels. In general, they require more combustion air, burn with a higher heat release in the chemistry of combustion, and produce more exhaust gas.

Possibility of Residual Fuel

Residual fuel may make an appearance as a fuel for diesel locomotives, but two things are powerfully operating against such a possibility:

1 Some designs of diesel engines now in use by the hundreds on the railroads just simply cannot burn residual fuel. What is to become of such locomotives? Many are new and most are still in trust.

2 Catalytic-cracking techniques are bent toward blotting out any residual liquid fuel. Residual fuels will ultimately be classed as a distinct "product" and must bear a selling price as a product, not as a "by-product." Such a pricing policy coupled with their expensive mode of handling on and off the locomotive will take them out of the economic picture as a railroad diesel fuel.

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[1] Compilation of papers published by AAR Purchases and Stores Division at 29th Annual Meeting, Chicago, Ill., May 16–17, 1955.

[2] *Scientific American*, vol. 181, December, 1949, pp. 32–39.

Contributed by the Railroad Division and presented at the Railroad Conference, Chicago, Ill., April 25–26, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Based on ASME Paper No. 57—RR-5.

Statistical Quality Control for

By Allan Fredhold, Jr., Mem. ASME

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ALTHOUGH statistical quality control is generally thought of as a mass-production technique for large industries, it can be used by small plants with profit. The theoretical background is complex, but a knowledge of basic arithmetic is sufficient for application.

Statistical quality control can increase production quality and decrease inspection costs, with other benefits in sales and engineering, and an increase in quality consciousness throughout the organization.

The basis of statistical quality control is the concept of "alikeness" rather than number. By "alikeness" it is meant that the production process is usually so stable that one part differs little from the one preceding or following it. Naturally, we cannot expect alike parts until production is stabilized and this stabilization process generally requires a sizable product experience.

Due to the many different types of products it is inadvisable to give an actual minimum numerical figure. For example: 100 machine parts might be as good an application as 5000 items produced by a punch operation. Basically, if the parts are thought to be "alike" and the number is such as to justify time for study, statistical-quality-control methods should be considered.

In looking at primary or fundamental statistical quality control we can start with two basic uses. One of these is the sampling of a large lot or number to determine its quality. This use finds its widest application in the inspection sampling of previously produced alike parts to determine the acceptance or rejection of the entire lot. The other basic use is in actual production. In this case, statistical quality control can provide a warning sign before any actual trouble is encountered. An example of this would be the process charts kept of certain dimensions on parts during production. By watching the charts, any trend of the critical dimensions to approach an expensive out-of-tolerance condition can be recognized and forestalled.

To benefit from statistical quality control it is advisable to have some idea of what it is. As we apply it, statistical quality control is a group of mathematical theorems that have been modified by an understanding of production. It has been compared to poker since both are based on the mathematics of the laws of chance or theory of probability. Yet, in application, an understanding of the "human" factors involved is more important than an understanding of the mathematics.

In any human system or human-designed machine nothing is apt to be perfect, nor is any part likely to be exactly like any other. Inspection and manufacturing are also apt to be imperfect. As a result of this recognition, statistical quality control sets up the premise that if it is not possible to be positive about quality, it is best to have a measvre of the probability of the quality. This probability and its measure, in combination with the realization of imperfectness, is the cornerstone of all applied statistical-quality-control work.

We can briefly illustrate the application of probability to our two fundamental applications. In inspection, sampling is justified by accepting the fact that the large group is probably "like" our sample. In other words, if our samples are "good" our larger groups are also apt to be good.

In using machine-control charts we calculate the probable extreme limits within which the stable process is apt to stay. If a measurement exceeds these limits it is probable that the process has changed and tolerances may be endangered.

The end object of all statistical quality control is, as the name implies, to control quality. This is in distinct contrast to the use of inspection departments in many shops, which are used primarily as screening stations separating the good from the bad and disposing of the defectives at considerable expense. Although statistical-quality-control procedures can be used in inspection, the procedures are not applicable to individual screening. In fact, statistical quality control's very existence is based on *preventing* defectives, not in finding them alone. However, the sampling procedures provide an ideal means for checking the quality of "screened" production.

Applied Inspection Sampling

Although much production is so individualized that statistical quality control is inapplicable, practically all shops use some "alike" parts in quantities that would justify sampling inspection. An example might be bolts, or any kind of fasteners that would be purchased and necessarily handled in quantity through receiving inspection.

Due to the great amount of government work being carried on, there has been more work in statistical sampling than in any other application of statistical quality control. In conjunction with this work, the government has issued a number of sampling plans which may be simplified and adapted to the particular requirements of the individual shop or process.[1] A descriptive sample adaptation is illustrated in Table 1 which is a normal sampling plan for an acceptable quality level of 1 per cent, which represents the percentage of defectives that probably will be passed in the long run.

With a lot size of 500 and "normal" inspection, for example, the odds are approximately 9 to 1 that 1 per cent defective items will be accepted if an acceptable quality level of 1 per cent is used in sampling inspection.[2] However, the odds are approximately 24 to 1 against accepting a lot that would reach 10 per cent defection.

Based on a paper contributed by the Management Division and presented at the joint Management Conference, New York, N. Y., April 25-26, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS and the Society for the Advancement of Management.

[1] "MIL-STD 105A," Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., September 11, 1950.

[2] "MIL-STD 105A," p. 29.

SMALL PLANTS

In actually selecting an acceptable quality level for any process, the maximum possible average number of defects that can economically be accepted must be decided and used as the acceptable quality level.

To make a decision, all the factors should be considered in the light of common sense and experience. Intangibles should be given consideration as well as such economics as the cost of 100 per cent screening inspection vs. the possible cost resulting from accepting some defectives through sampling..

As there are a multitude of sampling plans available with acceptable quality levels ranging from 0.015 per cent to 1000, an acceptable quality level can be selected that will provide both economical inspection and the necessary quality assurance. In fact, it has been the experience of many shops that increased quality can and will accompany decreased inspection through the use of statistical-sampling techniques. The actual necessity of using sampling inspection is of course best illustrated by such specifications as those requiring destructive tests.

Process Control Charts

Unlike sampling-inspection procedures, process control charts are mainly applicable where there is either continuous or large-lot production. Interpretation of the term "large" presents some difficulty. However, if we realize that setting up the charts and interpreting the results takes considerable time, we can see that it is improbable that control charts should be considered as an initial step unless the production process is expected to produce alike parts over a minimum period of several days.

As previously mentioned, process control charts are based on the theory of probability. In practice, initial production of alike parts is used as a foundation for the charts. From the production, an average is found of the critical dimensions, and then the variations from this average or dispersion, termed statistical tolerance, is calculated. Henceforth, any point that is charted outside of this tolerance represents an "out-of-control point."

As the control-chart boundaries illustrate what is probable, anything outside these boundaries is improbable. In effect, what is done is to graph the normal limits of the variation between measurements that is due to chance variation. If any measurement is outside of these limits, it is probable that some new outside cause is so affecting the process that stable production is no longer in effect and some engineering investigation is advisable.[3]

General trends can also be watched in the production sequence as illustrated by the plotted chart points. It is thus possible to anticipate such trend items as tool wear, loosening of adjustments, pollution of solutions, and the like.

By using the results of initial production, it is further possible to calculate what the reasonable design limits of a process may be. In this way, "impossible" requirements of new processes may be re-evaluated in a short time.

The actual development of a control chart involves some simple arithmetic as applied to a few standardized formulas. The only difficulty in understanding these formulas is that some statistical or mathematical symbols are used. For this reason, control-chart development is best illustrated by an example as shown by Tables 2 and 3 and Fig. 1.

Table 2 lists, in the first 3 columns, data concerning 10 sample groups. The fourth column lists the average X of the four measurements. The fifth column shows the range R of each group of four measurements. At the bottom of the fourth and fifth columns the totals have been divided by number of groups, 10, resulting in the grand average X in column 4 and the average range R in column 5.

In Table 3 the recorded data from Table 2 are used to calculate the statistical limits. The top group in Table 3, entitled "statistical parameters," lists the "constants" to be substituted into the necessary formulas according to the size of the sample in each group. These constants, along with the actual formulas, should be taken for granted at this time, subject to further study.[4] The final averages from Table 2 are used with the pa-

[3] Seven consecutive points on either side of the "average" also indicate probable lack of control.

[4] See reference (1) at end of paper.

Table 1[a] A Normal Sampling Plan

Acceptable quality level of 1 per cent[b]
Normal inspection level

Lot Size		Sample Size	Accept	Reject
Number of pieces or amount manufactured by stable production: "alike parts"		Number or amount of "alike parts" to be chosen at random and inspected	The entire lot will be accepted if this number or less are found to be defective[c]	The entire lot will be rejected and returned to the producer for screening if this number or more are found to be defective
2 to	8[d]	All	0	1
9 to	15	All	0	1
16 to	25	15	0	1
26 to	40	15	0	1
41 to	65	15	0	1
66 to	110	15	0	1
111 to	180	25	1	2
181 to	300	35	1	2
301 to	500	50	1	2
501 to	800	75	2	3
801 to	1,300	110	3	4
1,301 to	3,200	150	4	5
3,201 to	8,000	225	5	6
8,001 to	22,000	300	7	8
22,001 to	110,000	450	10	11
110,001 to	550,000	750	15	16
550,001 and over		1500	25	26
Example: Number of bolts in a box is 100		Example: Sample of 100 bolts is 15	Example: Accept box if no defectives are found in sample	Example: Reject box if one or more defectives are found in sample

[a] Adapted from MIL-STD-105A.

[b] May be considered as 1 in 100 if more than 1 defective/piece is considered.

[c] Defectives found will be replaced with "good" items.

[d] When sample size exceeds lot size, do 100 per cent inspection.

Table 2 X and R Control-Chart Data Sheet

Sample or group no.	Time of sample	Individual measurement X	Average of sample $\bar{X} = \frac{\Sigma x}{b}$	Range of sample $R = X_{max} - X_{min}$
1	8:00 a.m.	0.6856 0.6859 0.6860 0.6858	0.6858	0.0004
2	9:00 a.m.	0.6856 0.6845 0.6856 0.6855	0.6853	0.0011
3	10:00 a.m.	0.6857 0.6853 0.6855 0.6859	0.6856	0.0006
4	11:00 a.m.	0.6857 0.6864 0.6861 0.6866	0.6862	0.0009
5	12:00 noon	0.6869 0.6853 0.6855 0.6847	0.6856	0.0022
6	1:00 p.m.	0.6865 0.6860 0.6852 0.6871	0.6862	0.0019
7	2:00 p.m.	0.6865 0.6859 0.6861 0.6859	0.6861	0.0006
8	3:00 p.m.	0.6853 0.6861 0.6860 0.6862	0.6859	0.0009
9	4:00 p.m.	0.6865 0.6864 0.6866 0.6873	0.6867	0.0009
10	5:00 p.m.	0.6867 0.6867 0.6860 0.6870	0.6866	0.0010
Total			6.860	0.0105

Grand Average $\bar{\bar{X}} = 0.6860$. Average Range $\bar{R} = 0.00105$

Table 3 Control Limits

N Number of measurements in a group or sample	A_2 Statistical number for CLX	D_3 Statistical number for LCLR	D_4 Statistical number for UCLR	d_2 Statistical number for CLI
2	1.88	0	3.27	1.128
3	1.02	0	2.57	1.693
4	0.73	0	2.28	2.059
5	0.58	0	2.11	2.326
6	0.48	0	2.00	2.534
7	0.42	0.08	1.92	2.704
8	0.37	0.14	1.86	2.847
9	0.34	0.18	1.82	2.970
10	0.31	0.22	1.78	3.078

Control-Chart-Limit Calculations

Upper Control Limit for R = UCLR = $D_4\bar{R}$ D_4 for a sample of 4 = 2.28

Lower Control Limit for R = LCLR = $D_3\bar{R}$ D_3 for a sample of 4 = 0

UCLR = 2.28 (0.00105) = 0.00239

LCLR = 0

Upper Control Limit for X = UCL$\bar{X}$ = $\bar{\bar{X}} + A_2\bar{R}$ A_2 for a sample o 4 = 0.73

Lower Control Limit for X = LCL$\bar{X}$ = $\bar{\bar{X}} - A_2\bar{R}$

UCL$\bar{X}$ = 0.6860 + 0.73 (0.00105) = 0.6868

LCL$\bar{X}$ = 0.6860 − 0.73 (0.00105) = 0.6852

Individual-Control-Limit Calculations

Upper Control Limit for Individuals = UCLIX = $\bar{\bar{X}} + \frac{3\bar{R}}{d_2}$

Lower Control Limit for Individuals = LCLIX = $\bar{\bar{X}} - \frac{3\bar{R}}{d_2}$

UCLIX = 0.6860 + [(3)(0.00105) ÷ (2.059)] = 0.6875

LCLIX = 0.6860 − [(3)(0.00105) ÷ (2.059)] = 0.6846

Design tolerance statistically should be *greater than* $+\frac{3\bar{R}}{d_2} = \pm 0.0015$

rameter for group samples of 4 in the "control-chart-limit calculations." These limits are then shown on the graphs in Fig. 1 as broken lines.

Following the graph calculations in Table 3 the "individual-control-limit calculations" illustrate the method of finding the minimum design tolerance for individual pieces.

You will note that there are two charts in Fig. 1. The top one shows the variation of the average of the parts produced. The bottom chart shows the amount of difference between parts in a sample. The average chart shows the overall process and illustrates trends and influences on "total" production. The variation or range chart shows fluctuations from part to part.

Initially, as outlined previously, in the development of these two control charts, a group of four samples[b] is taken in consecutive sequence. A minimum of ten such group samples is usually required and 20 or more are advisable. The average $\bar{X}$ of the critical dimension X to be controlled is then figured.

[b] Four or five samples in a group are the most common, although conditions or experience may dictate a different number at times.

Next, the range R of each group sample is calculated by subtracting the smallest measurement in each group from the largest. After this, the total or grand average is figured as the average of the averages $\bar{\bar{X}}$ and the average range $\bar{R}$ is calculated. These two figures are used, as mentioned heretofore, in the proper mathematical formulas as shown in Table 3 to find the control chart limits.

In addition to providing the formulas and the statistical parameters to figure the control limits, Table 3 also provides a statistical number, d_2, used in figuring the probable limits of the actual parts produced. Remember that the graphs shown represent groups, not individual pieces. Using the equations shown, the statistical-individual-part limits can be found and referred to the original design limits, and then the economic feasibility of the process can be evaluated. A calculation of the part or individual limits is shown in Table 3. From this calculation we see that an original design tolerance of less than +0.0015 would be statistically, and no doubt economically, subject to question.

By using the control charts in Fig. 1 in this manner, a check is possible on both engineering and the process as related to each other. This is in addition to the advantages afforded by the recognition of a trend and the possibility of forestalling such a trend before an out-of-tolerance condition is reached.

As more sophistication is gained, the foregoing procedures and resulting applications can be adapted and expanded for wider and more profitable application. For example, process-control limits can be set from

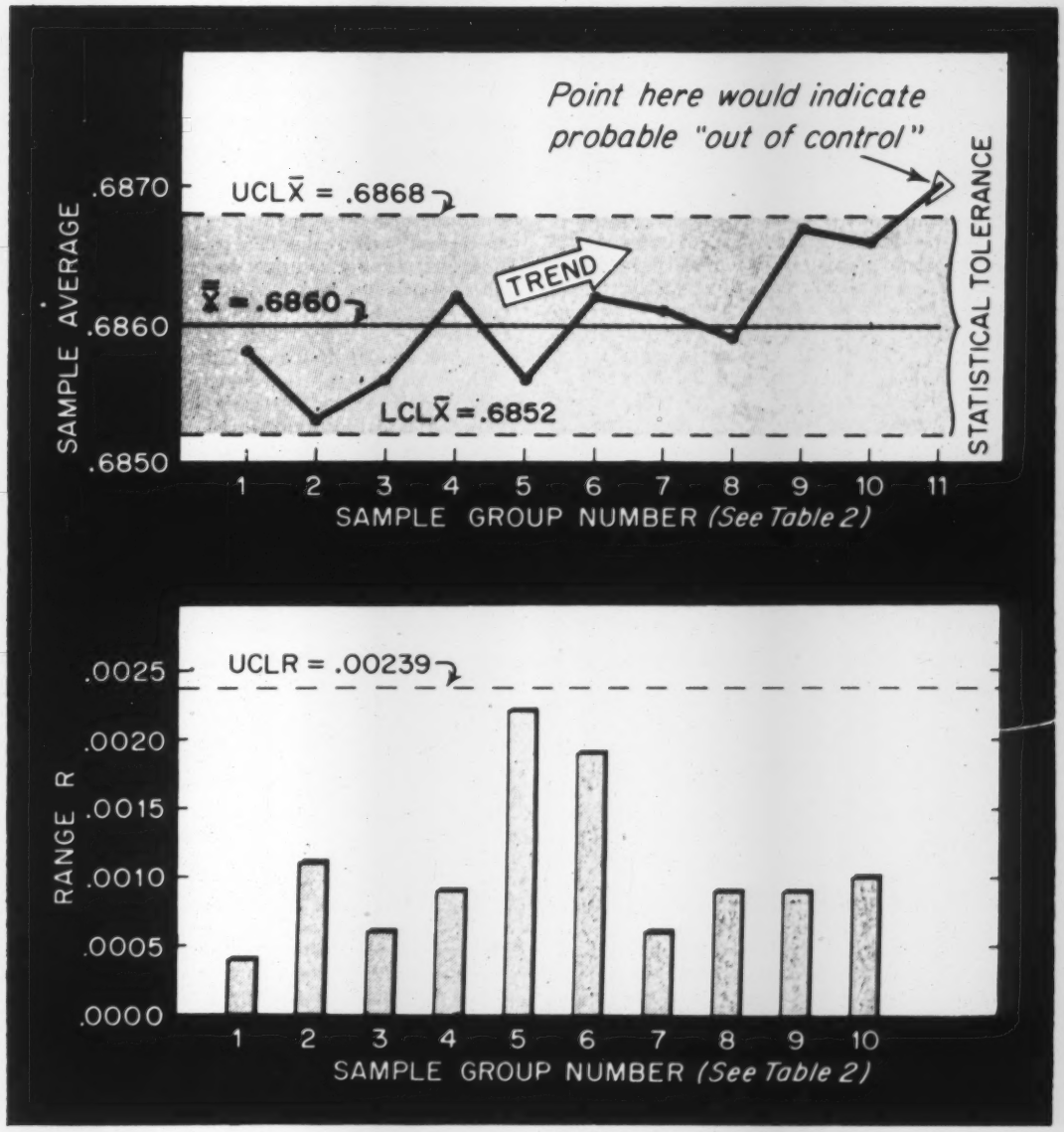

Fig. 1 Statistical quality control applications for the small plant, showing use of control limits and range

standard tables, and by relating these standards to the correct-specification limits, statistical controls can be applied to much smaller production lots. Furthermore, with a high degree of manufacturing consistency it may be possible to apply statistical controls to the same processes even though the actual individual parts requiring the similar processes are themselves different. In this manner, any job shop which employs similar operations on different jobs can gain an economic advantage by applying statistical controls to improve quality and reduce costs.

In conclusion, there are many applications of statistical quality control that can be made in the small plant. However, the two summarized here, sampling and process control, are the two most generally applicable. The information contained herein no doubt allows much to be desired from the statistical or basic-theory standpoint. However, this information was designed for application to the more prevalent cases and was based on a set of circumstances that may be encountered in other relatively small manufacturing operations.

References

1 "Statistical Quality Control," by E. L. Grant, McGraw-Hill Book Company, Inc., New York, N. Y., 2nd edition, 1952.

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Component fatigue analysis for

Vibration analysis and correction can do much to eliminate fatigue without redesign or substitution of parts

MANY problems facing the Plant Engineer or Maintenance Supervisor result from the demands of ever-increasing speeds and loads on production machinery. Increased speeds and loads begin to act on the weakest parts of machines and failures occur. These are usually fatigue failures, or vibration problems which can lead to fatigue failures.

Endurance Limits

The endurance limits for most materials have been published, but these have generally been obtained by laboratory test methods, and unfortunately, laboratory conditions are generally unobtainable on a commercial basis. For this reason it is necessary to review these data realistically and factor them as experience dictates. It is also recognized that many things such as forging practices, machining practices, lack of adequate fillets, and inadequate heat-treatment methods substantially lower the endurance limits of materials below published figures. Recognition of these factors and knowledge of the methods of overcoming them are tools the engineer must have to obtain good results from parts he designs.

Proper application of experience factors to known conditions constitute one method of producing results. Careful control of the methods of working the material and machining of the part, proper provision for filleting, and care in obtaining a good finish combine to constitute the most effective methods of obtaining satisfactory life from machine parts where existing design makes other changes difficult. In addition, other techniques are used to prevent fatigue failures.

It is necessary to have two conditions to have a fatigue failure. First, a load which is either pulsating or reversing, and secondly, a load in excess of the endurance limit of the material in the form in which it exists. Elimination of either of these factors will prevent a failure.

In some cases it is possible to eliminate the cycling nature of the load by preloading. This is especially adaptable to parts such as threaded connectors in pure tension. These are usually cylinder-head studs, connecting-rod bolts, foundation bolts, and such applications. While in themselves, these are small inexpensive items, failure from any cause can be very costly. Traditionally, the effects of cycling loads in fasteners have been treated much the same as other fatigue problems. Special-alloy studs, special-thread forms, reduced section and even axially drilled bolts have been employed to counteract the effect of cycling loads. It is true that these special forms are more resistant to the effects of a cycling load and many cases of repeated failure have been cured in this manner. In the case of fasteners in tension, the problem can be attacked more basically by eliminating the cyclic nature of the load. This is accomplished by prestressing the fastener to greater than twice the maximum applied load. It is important that the preload be more than twice the calculated maximum to take care of the rate of load application and hence allow for shock loading or suddenly applied loads.

Figs. 1 to 3 show the effect of a varying load on a fastener. Fig. 1 shows a plot of a force which we may assume is the force on the head of an internal combustion engine. We have plotted load against time. Fig. 2 shows the effect of such a load on a fastener normally tightened to about 20,000 psi preload. As you can see, every time the cylinder fires, the fastener is subjected to a shock load which momentarily increases its stress to 40,000 psi. Any bolt, no matter of what material or how shaped, would have a very short life if exposed to this condition. Fig. 3 portrays the suggested method of handling this problem. If we prestress the fastener to two or more times the maximum applied load, the stress in the fastener, though high, is constant and fatigue disappears.

Useful Technique

We have used this technique in many cases, such as occurred several years ago at one of our plants where a large press was used as an extruder. Inside the drive-

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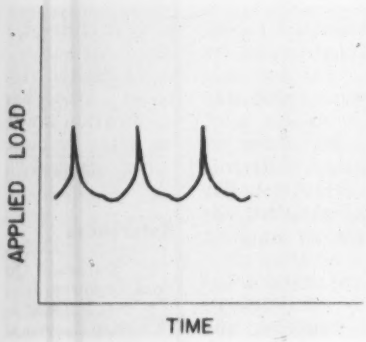


Fig. 1 *Left:* A plot of a force which we may assume is the force on the head of a combustion engine

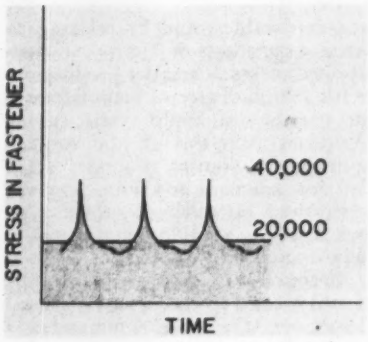


Fig. 2 *Right:* Effect on a fastener of momentary increase in load to 40,000 psi when the fastener is tightened to about 20,000 psi

maintenance

Maintenance Engineering Consultant Supervisor, du Pont Company, Wilmington, Del.

By R. J. Laux

gear box of this machine, the pinion shaft is held in place by two 1-in. socket-head cap screws. The direction of rotation is such that these two cap screws are in tension. Increased production demands brought increased loading, and one day the cap screws broke, allowing the pinion shaft to climb the gear. This did extensive damage to the cast-iron gear box. Spare parts were obtained, and the machine put back in service. About four months later, the operator noticed that the machine didn't sound right and shut it down. Investigation showed that one of the pair of cap screws had broken. Only good luck and an alert operator saved us from another damaged casting.

It was decided to place this item on the maintenance schedule and replace both cap screws every three months. During a 15-month trial period only one cap screw broke before it was changed. At this point, preloading of these cap screws was recommended to prevent failure. Our calculations indicated that tightening them to 500 lb-ft torque would put them well out of danger. We have not lost a single cap screw since they were tightened, and have also eliminated the concern that these fasteners might loosen in service. It is of interest to note that the fasteners used successfully were identical with those which failed. They were standard parts without special material or shape.

Since that time, this procedure has been used with success on all manner of threaded connectors on bearing plates, connecting rods, cylinder heads, split gears and many others, although it is recognized that application is limited to parts in pure tension or compression. It must be possible to preload the part and have the preload high enough to make other forces of no consequence. Parts such as pump plunger rods, piston rods, foundation bolts where bending occurs, crankshafts, and many other parts subject to cycling or reversing loads cannot be treated in this manner.

Standard Methods

In cases where loads cycle or reverse, and the part is subject to a changing stress, more nearly standard methods of combating fatigue failures are used. Attention is given to stress-concentration factors, and where possible, the stress is reduced. The use of heat-treated alloy steel is generally one of the first remedies the average engineer tries; however, the greater notch sensitiveness of harder materials reduces the endurance limit in actual service. Where the extra strength of the hardened alloy steels is vital, precautions should be taken to insure high-quality steel, properly heat-treated, properly machined, properly filleted, and carefully polished if the benefit of the high strength is to be realized. It has been found that almost every case of fatigue failure can be corrected by improved filleting and more careful finishing of the part. In the cases where hardened alloy steel is necessary, precautions are taken to insure a quality product in every stage of manufacture.

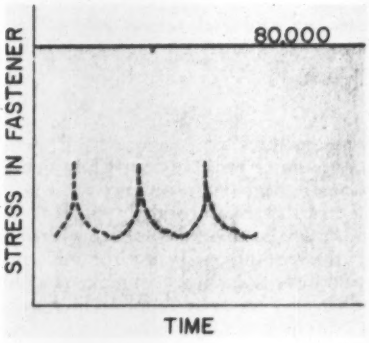


Fig. 3 By stressing the fastener to two or more times the maximum applied load, the stress although high is constant and fatigue disappears

These methods have been successful and will continue in use until better ones are found. If it's a fastener or other part that can be preloaded, it is preloaded; if it cannot be so handled, the design of the part is checked at changes in section for adequacy of fillets and care is taken to make sure that the part has a good surface finish in the areas where stress raisers might give trouble. In the rare cases where it has been necessary to go to the high alloys, the best finish possible has been obtained in the areas where stress raisers are unavoidable. Grinding and polishing of every fillet, and, in some cases, the entire part, has eliminated any heat-treatment crack or tool mark which could have caused trouble later.

Elimination of Cycling

Still another method of combating fatigue failure is attacking the cause of the cycling load. If it is possible to eliminate the cycling load, the fatigue problem no longer exists. Frequently the cycling load is due to vibration caused in imbalance of rotating equipment. The analysis of vibration and the reduction of elimination of destructive vibration is a fertile field for the elimination of fatigue failures and many other maintenance problems. Sources of unwanted vibrations are numerous. To mention just a few of the more important ones, there is balance, both static and dynamic, of rotating parts. Gears, unstable sleeve bearings, roller chains, silent chains, and even ball bearings may cause undesirable vibration. Inadequate foundations under heavy, slow, or high-speed equipment may be a cause of vibration.

One of the most deceptive problems recently encountered was that of vibration of a 9-ft-diam by about 110-ft-long kiln for calcining chemicals. It was heavily built and brick lined. Like most kilns, it was supported by two tires running on four rollers and driven by a girth gear through a gear box and a variable-speed drive. It was observed that, at a certain speed, vibration of the order of $^1/_4$-in. peak to peak occurred between the kiln and its support. The vibration was most severe on the drive-end platform, with the support on the other end of the kiln showing almost no relative motion. Our instruments showed that it was not the kiln but the A-Frame support on the drive end that was vibrating. These supports are heavily made of 8-in. × 8-in. × 1-in. angles well cross-stayed with 4-in. × 4-in. × $^1/_2$-in. angles. It was found that the erratic "stick-slip" motion of the kiln at a certain speed coincided with the natural frequency of the heavy frame, and serious vibration occurred. It was necessary to stiffen the support to raise its natural frequency above that of the exciting fre-

quency. An 8-in. × 8-in. × 31-lb wide-flange I-beam was installed as a support column under the kiln drive. Steel cables of $1^1/_2$-in. diam were installed as tension members from the top corners to the diagonally opposite bottom corners to reduce the swaying, and of course, action was taken to correct the prime cause of vibration which was in the kiln drive itself. These changes took care of the problem, and operation is now smooth over the entire operating range.

Vibrations From Imbalance

Vibration problems where imbalance is involved are often characterized by failure of some unrelated part. For example, an out-of-balance fan may cause failure of the casing or structural members supporting it. Foundation bolts may fail or, in some cases, failures occur which are traceable only to imbalance. An example of this occurred at one of our laboratory buildings. An excessive amount of maintenance was required on the balances and instruments in this lab. Investigation indicated that a certain exhaust blower was causing the trouble.

Investigation with a portable vibration analyzer showed that the major frequency did not coincide with blower speed. In about half an hour, the trouble was traced to an out-of-round flat pulley on the blower motor. A new pulley was recommended and the situation speedily corrected. Normal procedure would have been to remove the blower, ship it to a custom balancer, have it dynamically balanced, return it to the lab, and reinstall it, a process usually requiring about two weeks and five or six hundred dollars direct cost as well as the expense of lost laboratory time.

Several years ago, trouble was encountered with motor-generator sets which were mounted on a suspended platform about ten feet above the floor. Noise and vibration made the area very unpleasant when they were running. Because they were new equipment, the natural thing was to return them to the vendor with a total loss of time of three weeks. When they were reinstalled, they ran no better than before. Again they were returned to the vendor with another three weeks' loss, and again conditions were no better after reinstallation. At this point, our consultants were given an opportunity to correct the conditions with the portable vibration analyzer. In less than three hours, the trouble had been located and corrections made.

At another location, we checked new equipment shortly after installation to have a permanent record of how the machinery ran when it was new, and also to be sure the equipment was satisfactory. During this checkup we found a waste-disposal pump which had a vibration level in excess of the specified 0.006, and corrections were soon made to this equipment in agreement with the vendor.

Severe vibration of a 2-in. safety valve on the receiver for a large centrifugal compressor was simply corrected by adding a 2-ft by 2-in. pipe to the elbow, thus extending the discharge to add mass.

Methods and Equipment

Our organization has spent quite a few years studying vibration and methods of correction. We have purchased vibration-analysis equipment with a total purchase price of almost $10,000. This equipment is of several types. One is a General Radio Vibration Analyzer Type 762-B. This instrument can be tuned to simple vibrations in the range of 150 to 45,000 cpm to measure displacement, velocity, acceleration, and frequency of the simple vibration. It is a very accurate instrument for determination of frequency, and is customarily used with a General Radio Vibration Meter Type 751-B. The latter is used to measure displacement, velocity, and acceleration, and its principal use is in the accurate measurement of the magnitude of vibration.

In addition to these, we have two instruments manufactured by the International Research and Development Corporation. One is a Model 653; the other a Model 652-LF. The 653 has a range of 600 to 80,000 cpm, and the 652-LF a range of 300 to 20,000 cpm. These last two instruments are particularly useful because they can be used for balancing as well as for vibration detection and measurement.

We have spent much time in training men to use this equipment. As a result of this intensive study and experience to date, we are prepared to go to any company location and take care of almost any vibration problem. We can statically and dynamically balance rotating equipment in place on its own bearings and driven by its own motor. We can measure, and often correct, static or dynamic imbalance in a piece of rotating equipment running under normal full-load conditions. Beyond the knowedge of the capabilities of our instruments is the knowledge of the best instrument for a certain job and, even more important, the ability to interpret the readings in useful terms. For example, it is known that phase-angle shifts occur as we near the critical speed of a system, and the angle is almost 180 deg out of phase when beyond the critical speed. The principles of critical speed and natural frequency have received a great deal of study so that we now can do much to change critical speeds to suit our purposes better.

One example of this procedure concerned a machine used to wash yarn. The drying part of the cycle consisted of a high-speed spin to extract the water, much as an automatic washer does. The prime difference is that this equipment spins at about 6000 rpm. Recognizing that perfect balance at these speeds was impossible of attainment under operating conditions, the machine was designed to run above the first critical speed. This worked fine, except that the torque loads imposed by starting and stopping caused fatigue failure of the slender shafts. To eliminate these failures it was necessary to make the shaft stronger in torsion, but not change its spring rate or bending characteristics which would have changed the critical speed. Knowing that the modulus of elasticity of aluminum is about one third that of steel, we were able to design a new high-strength aluminum-alloy spindle with a larger cross section to withstand the high torque, and with the same length and spring rate as before.

Summary

Problems of fatigue failures of fasteners and other highly stressed machine parts probably will be with us for many years to come; likewise problems with both static and dynamic imbalance in rotating parts. We feel that the methods now in use in combating fatigue failures and the portable equipment in use for vibration analysis and correction have done much to make possible the increases in productivity brought about by increasing speeds and loads on our equipment.

Briefing the Record

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Editor*

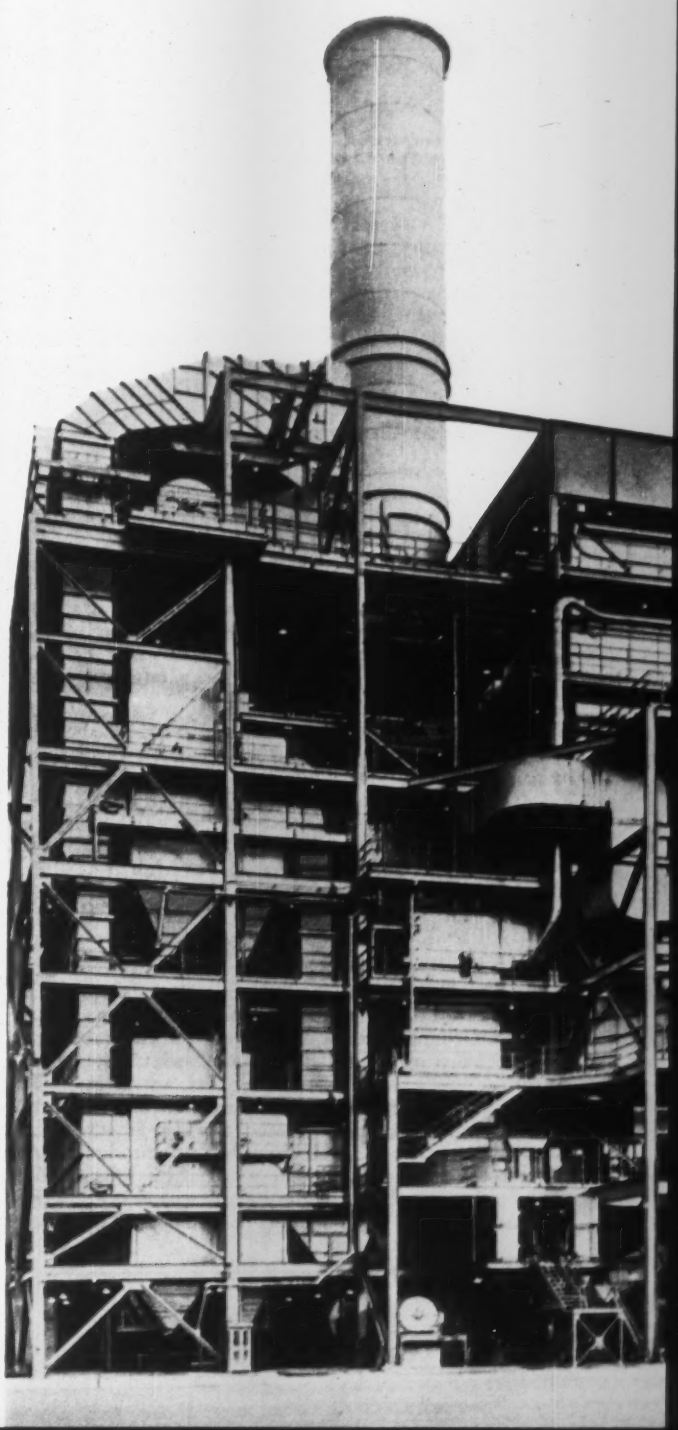
Automated Precipitators

AUTOMATION will play a major role in the gas-cleaning installation slated for the Bergen Generating Station now under construction by Public Service Electric and Gas Company, at Ridgefield, N. J. The new station will be the first to employ an automation system for the power inputs to the electrostatic precipitators, recently developed by Research-Cottrell, Inc., Bound Brook, N. J. Pilot models were field tested last year at the Burlington Generating Station of Public Service.

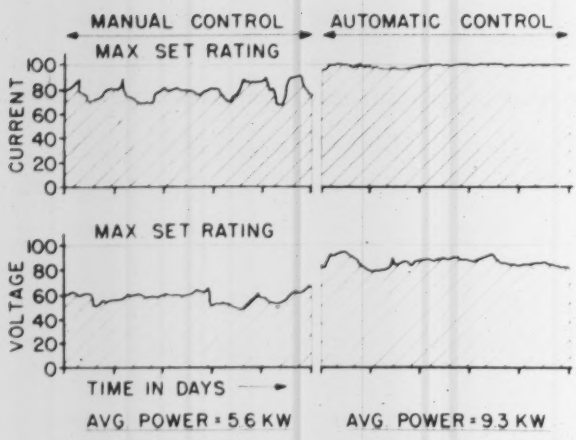
The gas-cleaning plant will consist of two combination mechanical-electrostatic precipitators. These will clean 1,800,000 cfm of gas—at 300 F, with 98 per cent efficiency—from two steam generators supplying approximately 4 million lb per hr of steam. The Cottrell automation system, known as the CA system, will eliminate conventional manual-control methods to provide peak 'round-the-clock' gas-cleaning efficiency. Electronic circuits, one for each individual electrical set, will continuously monitor precipitator operation to maintain sparking rate, current, and voltage at the levels necessary to obtain optimum fly-ash-collection efficiency.

It is characteristic of electrostatic precipitators that collection efficiency is critically dependent upon maintaining the maximum voltage and current across the electrodes to sustain the optimum sparking rate for the installation. Usually, this will be from 50 to 100 sparks per min. However, the power input needed to produce this optimum sparking rate depends on operating conditions that may be undergoing constant change. Such conditions are gas temperature, composition, rate of flow, or humidity, as well as dust size, resistivity, and build-up on electrodes.

In conventional precipitator operation, it is necessary that an expert operator be in constant supervision for 24 hr a day at control panels. Experience has shown that even with three shifts of full-time operators, it is impossible to detect and correct changes as fast as they occur, and thus obtain optimum results. This is especially true in large precipitator installations where as many as 6 electrical sets have to be adjusted and interrelated.



Research-Cottrell double-deck combination precipitators at the Burlington Generating Station of Public Service Electric and Gas Company of New Jersey. Pilot models of the new Cottrell automation system to be installed at the new Bergen Generating Station were field tested at this plant.



Performance comparison of Cottrell automation-system control, and manual control of precipitator power input

With the CA system, continuously acting electronic-feedback circuits constantly monitor sparking rate. They adjust the power input instantaneously to maintain sparking at the predetermined rate that assures optimum collection efficiency. No supervision is necessary, other than the initial action of turning the remote-control switch that puts the precipitator into operation.

Supercritical Generator

GENERATING unit No. 6 at the Ohio Power Company's Philo Plant, the nation's first supercritical-pressure generating machine, has been operating under test conditions since March 20.

Philip Sporn, Fellow ASME and president of American Gas and Electric Company and Ohio Power, its subsidiary operating company, described the unit as a milestone in the history of electric-power generation.

Briefly, here are some of the things this new machine will do—all of which are "firsts" in the industry:

1 Utilize steam above the critical pressure of 3206 psi, the point at which superheated water flashes immediately into steam without first passing through an intermediate "boiling" stage.

2 Operate at a steam pressure as high as 4500 psi, almost double the highest pressure previously used in commercial power generation.

3 Operate at a steam temperature as high as 1150 F—50 deg above the highest temperature previously used for this purpose.

4 Utilize double reheat of steam during its passage through the turbine.

Philo 6, which has been more than 30 yr in evolution, is the result of the combined efforts by American Gas and Electric, General Electric Company, and The Babcock & Wilcox Company. GE designed and built the steam generator.

By virtue of its new design features, Philo 6 is expected to operate commercially as the world's most efficient generating unit. It will be able to produce more electric energy from a pound of coal than any other power-generating machine to date.

Although it is of a smaller capacity, 120,000 kw, or about 160,000 hp less than other generating units recently placed in operation on the seven-state AGE System, this particular size was chosen as ideal and practical for development purposes.

Experience gained from its design and construction already has been put to good use. This unit has served as the predecessor to the AGE System's two new 450,000-kw units—the world's largest power producers. One of these giant units is being built by Ohio Power at the Philip Sporn Plant, Graham Station, W. Va.; the other by its sister company, Indiana & Michigan Electric Company, at the Breed Plant in Sullivan County, Ind.

Small Electronic Brain

A HIGH-SPEED digital computer, not much larger than a home television set, and requiring less power to operate, has been developed at Bell Telephone Laboratories.

This newest addition to the family of electronic "Brains," named "Leprechaun" after the tricky sprite of Irish folklore, was developed under Air Force contract.

Compared with previous computers, Leprechaun operates with a drastically reduced number of components. Excluding its magnetic cores, it uses only about 9000 electrical components. More than half of these are transistors, tiny electronic devices invented at Bell Laboratories which make possible the small size and low power requirements of the computer. Some 5000 of them are used in the Leprechaun.

Leprechaun represents a significant advance in computer design. One of its outstanding features is its flexibility. Its components can be easily connected and disconnected. This allows it to be used as a test model for research on digital computers. Proposed new designs can be laboratory tested without resorting to construction of new equipment.

Another feature of the new computer is its transistor-driven "random-access magnetic-core memory." The machine can take its instructions immediately from its memory, no matter where the desired instruction may be

The Leprechaun, a new digital computer developed at Bell Labs under Air Force contract, occupies only slightly more space than a home television set and requires less power to operate

stored. This process differs from that of computers with a "revolving drum memory" which may require time for the rotation of the drum before the instruction can be taken from its place.

Almost instantaneous solutions to the problems it has to solve are provided by Leprechaun, since any of its stored instructions are immediately available. Each instruction consists of the operation to be performed, such as addition, multiplication, or similar applications, and the location of the data in the memory.

The single-address stored-program machine can store 1024 "words" in its magnetic core memory, including a parity check bit that serves as a check on memory operation only. Access is provided by coincident voltage magnetic core diode switches. Using a system of staggered read drive, a 20-microsec read-write cycle has been achieved. These words consist of 18 binary or dual digits, representing instructions or data to be used in solving problems. In computers, all information is translated into a special code which uses only combinations of 0 and 1. These binary digits can be represented in Leprechaun by the flow or absence of electricity in the transistors, by the direction of magnetization in the memory cores, or by holes in punched paper tape.

In logical organization, Leprechaun is parallel, asynchronous, and all shifting registers and counters use the double-rank technique. In general, the major units of the computer operate almost independently, at their own speed, doing as much as they can until forced to stop and wait for the services of some other busy unit.

The operation code for Leprechaun provides all the common arithmetic, logical, and transfer operations. A special feature is an unconditional jump operation (subroutine jump) to simplify the inclusion of short subroutines in a program. The first use of the operation transfers control to the desired loop in the program; the second use returns control to the point in the main program from which the jump was made.

A simplified address modification operation has been designed into Leprechaun in which modification is accomplished by direct substitution. The contents of a 5-bit Address Modifier Register are substituted for the five least significant address digits of all instructions in which these five digits are zero. This does not alter the stored instruction and requires no tags on the instructions to be modified.

One reason for building Leprechaun was to demonstrate the feasibility of "direct-coupled transistor logic." This is a switching circuit technique in which transistors are used to perform logic or "brain" operations as well as to provide power.

Compared with previous computers, the circuits of Leprechaun are very simple and easily understood. This is an advantage in engineering and maintenance, since less experienced personnel are required to keep it in operating condition. Leprechaun's simplicity and small number of components result in small size and weight and will permit the use of automation techniques in manufacturing. All these features insure greater reliability, which is of primary importance in military operations.

While Leprechaun is still in the experimental stage, the techniques developed are expected to have many future applications.

The intricately wired Leprechaun uses about 500 transistors in its 9000 electrical components, which represent a drastic reduction over the number of components used in other computers

Aluminum Sheet and Plate

To meet the requirements for the production of wings and other aluminum components of aircraft, the Reynolds Metals Plant at McCook, Ill., has dedicated a new, fully integrated tapered sheet and plate rolling and processing mill.

One of two completely integrated sheet and plate mills in the company structure, the McCook facility has a capacity of 30 million lb per month of sheet and plate, and employs 2600 people with an estimated $\$1^1/_2$-million monthly payroll. Housed in 5 of the 36 buildings of a plant built during World War II at a cost of $43 million, the equipment includes a 145-in. tapered rolling mill, largest of its type; twin fixed-bed gantry-type skin millers with a work bed over 100 ft long, and the world's largest plate stretcher with a pulling force of 16 million lb.

Synthetic Rubber

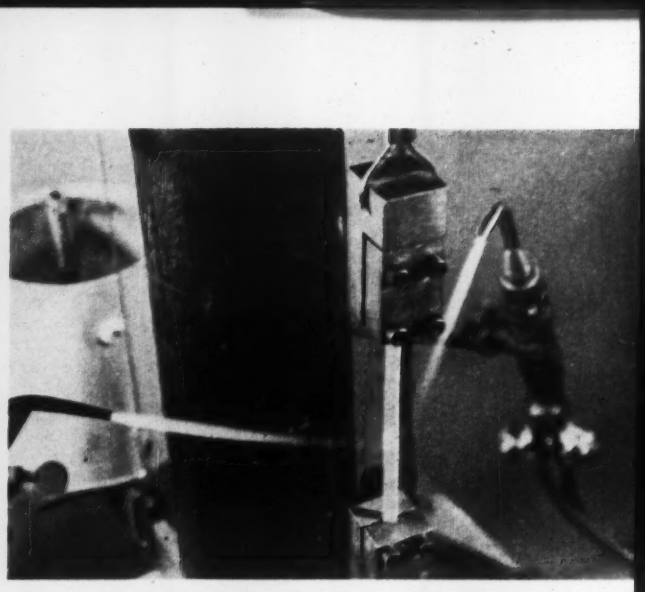
A recently completed 50 per cent expansion program costing nearly $10 million, which will boost production capacity of Plioflex rubbers at Goodyear Tire and Rubber Company's Houston, Texas, synthetic plant to 220,000 long tons a year, makes the plant the world's largest single producer of dry-type synthetic rubbers.

"Indications are that within a few short years, world-wide demand for rubber will exceed present supplies, and we have moved to beat what could otherwise develop into an acute shortage of this vital material with runaway prices," company president E. J. Thomas said.

Two completely new reactor lines, each containing 11 reactors of 5000 gal capacity each, and a new recovery area with three new stripping columns, have been added.

Also, included in the expansion program are spherical butadiene blend tanks of 210,000-gal capacity each, which make possible a sevenfold increase in storage capacity of butadiene. Styrene storage capacity also has been increased proportionately, along with other processing and finishing units.

Radomes, made from Pyroceram are taken at white heat from the forming machine and rushed to the annealing oven, shown here. Before the final heat-treatment, Pyroceram radomes are transparent; they turn into a hard, opaque crystalline material after treatment, ideally suited to the intense heat of guided-missile applications.



Even under the heat of two acetylene torches and with weights pulling at each end, this rod of Pyroceram maintains its strength indefinitely. Flexural strengths as high as 80,000 psi have been measured on certain Pyroceram materials. Thermal expansion can range from slightly negative to 200 $\times$ 10^{-7} per deg C, compared to 95 $\times$ 10^{-7} per deg C for stainless.

Pyroceram

DEVELOPMENT of a new family of basic materials, called Pyroceram, harder than high-carbon steel, lighter than aluminum, and up to 9 times stronger than plate glass, has been announced by Corning Glass Works, Corning, N. Y.

More than 400 different Pyroceram compositions have been developed at Corning's research laboratories. The first commercial use of these new materials will be for a guided-missile radome.

The announcement marked completion of Corning's new research and administration center. Named Houghton Park, in honor of the company's founding family, the glass-sheathed buildings were dedicated to Corning's employees.

Pyroceram is claimed by Corning to be one of the greatest technological advances in glass research since the discovery of heat-resistant borosilicate glass early in the 20th century. By a revolutionary manufacturing process, noncrystalline glass is turned into a hard, nonporous crystalline material.

Pyroceram can be tailor-made with thermal expansions ranging from slightly negative to high enough to match those of heavy metals. It can have electrical insulating properties superior to those of the best commercial dielectric ceramics. It can be made opaque or it can be transparent, the first polycrystalline material ever to exhibit this optical property.

Experimental Pyroceram compositions have flexural strengths as high as 60,000 psi. The strength-to-weight ratio of one Pyroceram is identical to that of annealed aluminum, greater than that of titanium and stainless steel.

Certain types of Pyroceram keep their strength at temperatures as high as 1300 F. With its high strength-to-weight ratio, lightness, and excellent thermal characteristics, Pyroceram has great potential use as a substitute for aircraft metals.

Pyroceram also has great flexibility in forming. It

New Refractory

A NEW basic refractory for open-hearth steel furnaces has been announced by Corhart Refractories Company, Inc., a subsidiary of Corning Glass Works.

Called Corhart 104 Electrocast Refractory, it has extremely high corrosion resistance, high load bearing strength at elevated temperatures, melts above 4300 F.

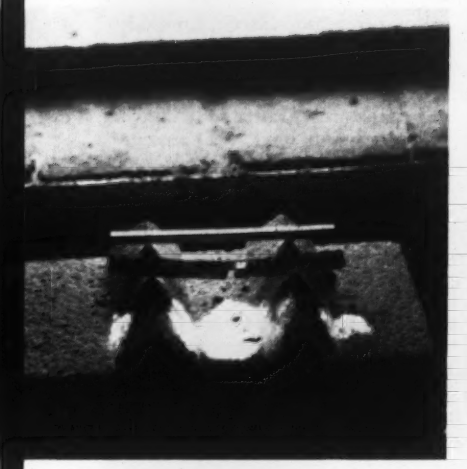
It can be used, the company stated, for sprung arch roofs, skews, front wall piers, downtakes, and walls, and back walls in open-hearth furnaces. Greater furnace production per day and lower furnace maintenance costs are possible through increased longevity of the refractory at higher operating temperatures.

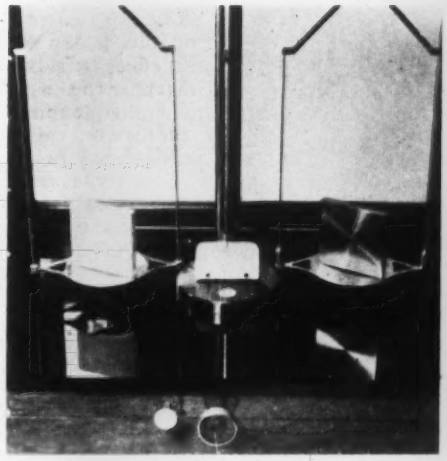
Corhart 104 bricks used in sprung arch roofs have been responsible for increasing individual furnace productivity in test runs by as much as 20 per cent.

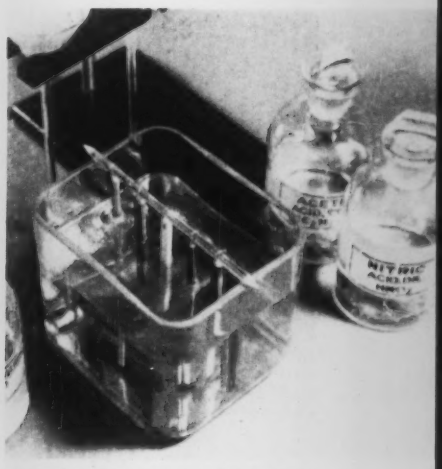
Because of its great resistance to corrosion at high temperatures, Corhart 104 can be used in electric steel furnaces at the slag line and in hot spot applications. This new basic refractory is strong enough to support its own weight in a sprung arch roof, with consequent savings in labor and downtime over hung roofs.

Characteristic structure makes Corhart 104 more impermeable to gases and slags than conventional steel-furnace refractories.

Corhart 104 is a magnesite-chrome basic refractory manufactured by electrically melting raw materials at 4300 F. The molten refractory is poured into molds of various sizes and shapes.







Pyroceram has no recorded loss of strength at temperatures as high as 1470 F. This Pyroceram is still rigid *left*, after furnace temperatures hot enough to melt copper bar, cause steel bar to sag. This Pyroceram is as light as aluminum, *center photo.* Another Pyroceram developed by Corning Glass Works is actually lighter than aluminum. By controlling batch ingredients and final heat-treatment, Pyroceram materials of different physical properties can be produced. Certain Pyroceram materials have excellent chemical stability, *right photo,* can withstand acid and alkali attacks. Steel, aluminum, copper, and magnesium rods were all affected by aqua regia acid; Pyroceram remained completely unharmed.

can be made into large or complex shapes by any of the known glass-forming techniques. It is adaptable to mass production, and can be passed, drawn, blown, rolled, and centrifugally cast.

Another advantage in formability is the fact that certain types of Pyroceram can be formed by investment casting techniques such as those used in metal foundries, enabling it to be fashioned into complex, close tolerance parts.

One Pyroceram developed by Corning is lighter than aluminum and has a flexural strength of 40,000 psi. It is presently being developed as the material for missile radomes.

The cone of Pyroceram protects the sensitive directional instruments in the nose of the missile from the sudden high temperatures experienced in hypersonic flight. The softening point of this Pyroceram is 2460°F, which is above the melting point of some stainless steels.

Thermal shock resistance of some of these new crystalline materials is greater than that of dense alumina and equal to that of fused silica. The resistance of one Pyroceram to acid and alkali attack is nearly as good as that of Pyrex brand borosilicate glass.

The new materials are melted and formed like glass, with each batch containing one or more nucleating agents. Subsequent heat-treatments cause the nucleating agents to form billions of submicroscopic crystallites in the Pyroceram. As the heat-treatment continues, each crystallite acts as a center of crystal growth.

It is by controlling the chemical composition and growth of these crystals that Pyroceram is made with a variety of properties.

The end product, after heat-treatment, is an extremely fine-grained crystalline material, nonporous, impermeable, and harder than most ceramics and many metals.

Pyroceram will probably cost little more than glass and far less than stainless steel. Of the 1000 experimentally made types, four have been selected for pilot runs.

Nonferrous Metals

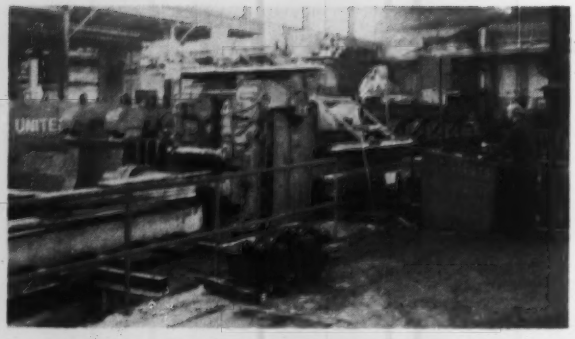
Good management and $1.5 million have resulted in a 4½ times step-up in bar-milling capacity from 200 to 900 lb and other increases in the production of phosphor bronze, nickel silver, beryllium copper, and cupro nickel alloys in rod, bar, and wire form.

The Riverside Metals Company was using antiquated methods in an obsolescent plant at Riverside, N. J., when it was acquired by the H. K. Porter Company, Inc., in 1954. The breakdown mill, which performs the heavy first rolling, was hand fed by four men who had to relieve each other at the task. All handling is now hydraulically operated. A single operator controls the entire operation by push button—lifting, stacking, turning, and feeding 900-lb bar stock with a variety of devices.

Process flow, which was a confused 4000-ft-long crisscross from cut slabs to finished coils of strip, has been reduced 70 per cent to a total of 1200 ft.

A new 4-high Bliss rolling mill has replaced several older mills and is equipped with a horseshoe-shaped run-around roller conveyer to return the coils after each pass through for further rolling. A new 200-ft roller-hearth furnace handles simple annealing, while new bell-type furnaces have also increased annealing capacity and improved metal qualities by minimizing oxidation.

In addition to the capacity increases, there has been a $300,000 per yr saving in operating costs. According to W. Harvey Thompson, vice-president and general



In modernizing the Riverside Metals plant, the breakdown mill, where the first rolling operation is performed, was equipped with hydraulic handling equipment. One man now does the work of four.

A new 4-high Bliss rolling mill has replaced several older mills, and is equipped with a horseshoe-shaped run-around roller conveyer to return coils after each pass through for further rolling

manager, these are only the first of the physical changes contemplated by H. K. Porter. New casting facilities, special wire operations, and a specialty mill to handle 24 to 26-in. bar, are among them.

Oil-Well Power Drill

AN OIL-WELL drilling "engine," which operates at the bottom of the hole, is expected to double or quadruple drilling speeds through the hardest oil-field rock, according to tests by Gulf Oil Corporation.

The development, unveiled during the recent Gulf Research Center dedication ceremonies (see "Roundup" in this issue), will soon be available to the industry. In effect, it solves the problem of adding a percussion hammer to the end of the drill string.

Full-scale runs at Gulf's Research Center indicate that the device, called the "percussion drill" or "hammer drill," may be one of the major drilling improvements.

The tool is expected to provide savings in money, time, and maintenance as a result of faster penetration. It also promises to help solve the costly problem of maintaining straight holes in hard, slating formations. Under some conditions it increases the life of drill bits.

The tool consists of a reciprocating piston and cylinder arrangement for delivering percussion blows. It is powered by the drilling mud which must be kept circulating through the hole to carry off the drilled-up rock, giving it the additional name of "mud engine."

The device is encased in a cylinder approximately 19 ft long which hangs at the end of the drill string, with a conventional roller bit fastened directly below. As the drilling mud circulates through the mechanism, it drives a 200-lb hammer delivering 600 or more strokes per minute on the attached bit.

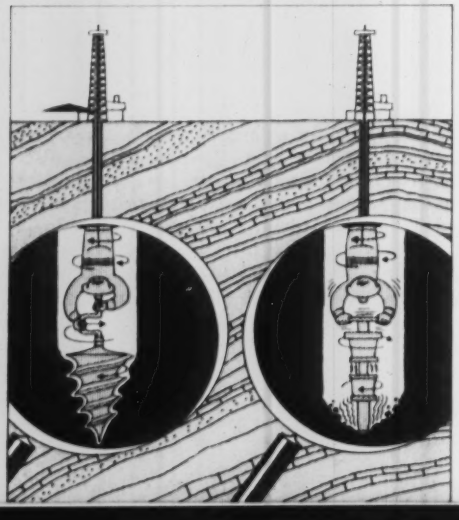
Meanwhile, the drill is slowly rotated under a load which may be from 6000 up to 40,000 lb, depending on down-hole conditions. The bit points are thus successively positioned and driven against the hole bottom in a manner similar to that in which star drills are turned to make holes in masonry. Hanging almost like a plumb bob at the end of the string, the percussion hammer chops a vertical passage downward despite the hardness or the slant of the formation.

By contrast, in conventional drilling the bit is attached directly to the end of the drill string, and is rotated against the bottom usually under heavy loads, averaging from 25,000 to 55,000 lb. Hence it progresses by chewing or boring, into the rock.

These differences account for the "hammer drill's" faster penetration. In original field tests, where it drilled more than 6000 ft in 32 different holes in West and East Texas, Oklahoma, Nevada, and Canada, the new tool often achieved a rate of penetration (ft per hr) 25 to 50 per cent better than conventional tools.

Since then, on the basis of laboratory tests, it is estimated that an improved model will increase penetration through chert, dolomite, and hard limestone by two to four times over present rates.

Operationwise, field trials demonstrated the new tool could operate 60 hr without withdrawal for servicing. With recent improvements, 100 hr without withdrawal are anticipated. When taken from the hole, simple replacements can be made right on the rig, and the tool put back to work.



Double to quadruple drilling speeds in hardest rock are expected with the new "power drill" unveiled recently at Gulf Oil Research Center. Instead of simply boring a hole as practiced for the past half century, *left*, a percussion-hammer mechanism has been added to the end of the rotating drill string, *right*. Powered by circulating drilling mud, it delivers 600 and up blows per minute, chopping and cutting through tough oil field rock at an improved rate.

Ultrasonic Emulsifier

A NEW line of less expensive and easier-to-maintain ultrasonic emulsifiers employs an entirely new principle of operation. It also offers faster and more complete emulsification.

The fluid-dynamic forces of the liquids themselves are used to produce the sound waves, instead of generating the ultrasonic energy outside the liquids. This is accomplished by impinging the liquids to be emulsified in a jet stream on the edge of a blade. The blade vibrates at its natural frequency, about 22,000 cps. Cavitation occurs continuously in the stream rushing past the blade. All energy is developed and used right in the liquid.

Recently developed in England, these emulsifiers, called the Rapisonic, Autosonic, Dispersonic, and Minisonic, have found complete acceptance in the pharmaceutical, food, cosmetic, plastics, leather, chemical, lubricant, paper, rubber, photographic, automotive, and textile industries.

The Rapisonic, consists of a gear-type pump and ultrasonic head driven by a 2-hp motor. It has an output up to 350 gal per hr and handles emulsions of high and low viscosity. The machine produces a homogeneous field; no premix is necessary. It is easily bolted or clamped to any firm support near the processing vessel.

The Autosonic emulsifier meets the need for continuous supply of emulsion automatically geared to process volume. The oil, water, and emulsificant are pumped separately into the Autosonic via three control valves and flow-rate indicators in order to adjust the proportions of each in the final emulsion. Float switches maintain a balance in a reservoir by starting and stopping the feed and discharge pumps as well as the emulsifying unit. The Autosonic incorporates the Rapisonic emulsifying unit.

The Dispersonic is designed to handle dispersions of powders in liquids or emulsions of an abrasive nature. While it uses the same type of ultrasonic head, it substitutes a continuous-cavity pump for the gear pump of the Rapisonic, in order to better resist the abrasive effects of many powders when they are pumped at the pressures required for the development of ultrasonic energy. A 3-hp motor provides a continuous output of 300 gal per hr.

The Minisonic, a batch-type machine with a capacity of 1 gal in the double-shell funnel reservoir is for laboratory or pilot-plant use. Progress of emulsification can be observed in the transparent hose running from the ultrasonic head to the reservoir. This model also handles emulsions of high and low viscosity.

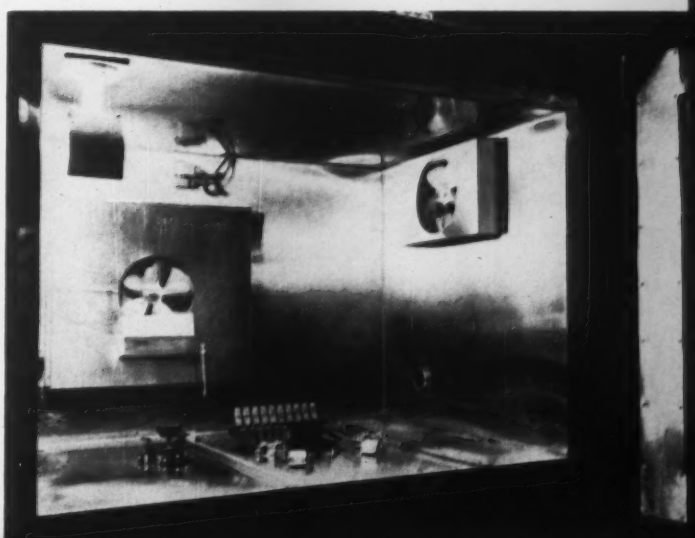
The Minisonic ultrasonic emulsifer, is a 1-gal capacity batch-type machine which uses the fluid-dynamic forces of the liquids themselves to generate ultrasonic energy

Vapor Refrigeration

BY SCRAPPING everything in a conventional refrigeration unit except the basic principle, Associated Testing Laboratories of Caldwell, N. J., has developed a refrigeration system so simple and direct as to border on the radical. This novel system has no compressor, condenser, or heat exchanger; in fact, no moving parts except for one valve. Cooling is produced directly by the vaporization of liquefied CO_2 or other gas released into the refrigerated area through the control valve without the use of heat-exchange coils. The result is exceptionally efficient and rapid cooling, close temperature control, and highly economical operation.

This refrigeration system is used in a series of environmental test chambers ranging in size from 1 cu ft to walk-in rooms. The ATL chambers contain three systems for producing a wide range of environmental conditions: (*a*) A refrigeration system, to maintain temperatures down to −108 F with CO_2 and lower with other gases; (*b*) a heating system, to maintain temperatures up to +600 F; and (*c*) a humidifying system, to

Interior of a typical environmental test chamber. Vaporized CO_2 or other liquid gas is injected through the valve just above the open top of the fan housing for refrigeration. The strip heaters are behind the fan housing. The dry-and-wet temperature sensing bulbs (coiled for greater surface area) are located directly in front of suction fan where they are continuously exposed to the airstream drawn from throughout the cabinet area.



maintain any desired relative humidity between 5 and 100 per cent. The refrigeration and heating systems are both controlled by one Fenwal Series 541 temperature controller; relative humidity is maintained by a second Series 541 controller.

Typical of the efficiency and performance of the entire line is the 32-cuft test chamber. This unit reaches −100 F from room temperature within 5 min, as compared with $1^1/_2$ to 4 hr (depending upon compressor rating) for mechanically refrigerated equipment. Because of the design of the refrigeration system and the efficient air-circulating system, the temperature controllers can approach their rated accuracy, and maintain a temperature uniformity within ±1 deg C throughout the chamber—about half the variation permitted by government testing standards.

The cost of the complete test chamber is about one fourth that of conventional cabinets of comparable capacity, largely because of the vastly simplified refrigeration system. Furthermore, the Associated Testing cabinets cost about 50 per cent less to operate than do conventionally refrigerated cabinets. These relative costs compare the 32-cu ft chamber with a conventional chamber of roughly equivalent cooling capacity. They include the cost of the original equipment amortized over 5 years, the liquefied gas, electricity, plus cooling water, and service for refrigerated systems.

250-Megawatt Turbine Test Pit

Allis-Chalmers has initiated full use of a large new turbine test pit at its West Allis (Wis.) Works with the current testing of the 3600-rpm elements of a fourth 120,000-kw close-coupled, cross-compound unit for the Oak Creek station of the Wisconsin Electric Power Company.

The new pit, equipped with steam connections, condenser equipment, lubrication system, and co-ordinated test instrumentation, is capable of testing units up to and including 250-megawatts, 3600-rpm.

The pit is a single long opening in the main assembly area of the plant. It has no internal partitions or permanent platforms, and turbines can be erected on any particular part of it. The pit floor is a 4-ft-thick reinforced-concrete slab topped by 12-in-thick, precision-leveled floor plates. Two 250-megawatt tandem turbines can be assembled lengthwise in the pit and tested simultaneously. When the entire space is not in use, the pit can be shortened by installing heavy concrete and steel slabs on columns to provide additional shop floor space.

Of particular interest is the system developed for furnishing foundations for shop erection. A master set of cast-iron parallels is composed of eight standard blocks, combinations of which are used for different ratings. A total of 32 is needed, for example, for the shop erection of the 3600-rpm elements of a 300-megawatt unit.

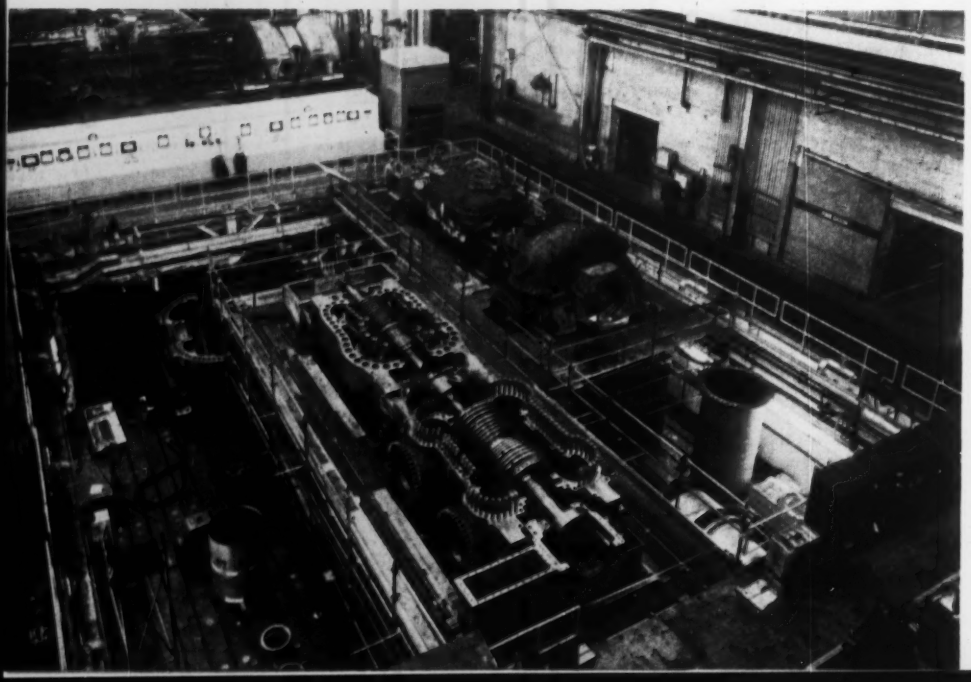
Four-inch expandable steel blocks are used on top of the upper parallels. During shop erection, these base pads are shimmed to dead level by optical-leveling methods and then are bolted to the foundation parallels.

The turbine sole plates are mounted on top of the leveled base pads and the level of subsole plates in the field is similarly established. Shim packs made up during shop erection can be transferred to the field without alterations, thus reducing time for leveling and line-up during erection at the site of installation.

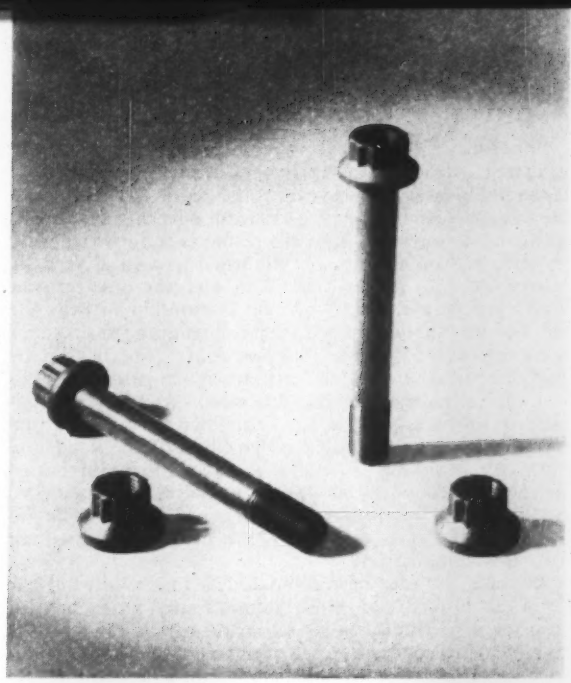
A permanent test-pit lubrication system includes two 4000-gal oil tanks with motor and steam-driven auxiliary oil pumps and oil coolers. Two consoles at the main shop-floor level contain oil-pressure regulators, oil-flow controllers, oil-flow meters, and pressure gages.

A central control panel with motor and valve controls, steam-pressure and temperature gages and records, steam-flow meters, condenser gages, and a barometer is mounted between the lubrication-system consoles. A service elevator adjacent to the console assembly operates between the main shop floor and the pit floor.

High-pressure and intermediate-pressure elements for the world's first 300-megawatt unit for the Detroit Edison Company are being assembled while the 3600-rpm high and intermediate-pressure elements for Oak Creek No. 4 are being tested. This new integrated assembly and test pit is one of many large facilities required to produce today's large steam turbogenerator units of which 100, 120, 150, 200, 220, and 300-megawatt ratings are being manufactured by Allis-Chalmers.



Allis-Chalmers new turbine test pit is capable of testing units up to and including 250 megawatts and 3600 rpm. Two 250-megawatt tandem turbines can be assembled lengthwise in the pit and tested simultaneously.



Bolts that can hold together supersonic aircraft and permit major advances in high-temperature design in other fields, have been announced by Standard Pressed Steel. The new Hi Tm 9 family of fasteners represents a unique wedding of exceptional strength and temperature resistance. With minimum tensile strength at 170,000 psi at 900 F, the bolts are as much as 50 per cent stronger than stainless and alloy-steel fasteners currently used at this temperature. Other immediate applications for Hi Tm 9 include aircraft engines, power-plant steam and gas turbines, high temperature nuclear, and chemical-process equipment.

Fasteners for 900 F

HEAT-DEFYING steel superbolts that can hold together supersonic aircraft, and permit major advances in high-temperature structural design in other fields, have been introduced by Standard Pressed Steel Company, Jenkintown, Pa.

The fasteners called Hi Tm 9 have minimum tensile strength of 170,000 psi and shear strength of 100,000 psi at 900 F—the friction-generated skin temperature of an airplane speeding through the atmosphere at 2400 mph (Mach 3.5).

The SPS fasteners are made from VascoJet 1000, a 5 per cent chromium hot-work die steel produced by Vanadium-Alloy Steels Company of Latrobe, Pa. They have 50 per cent more strength than the alloy-steel fasteners currently used.

Initial fasteners, designated EWB Tm 9, are a 12-point external-wrenching type of aircraft tension bolt used for airframe fastening, ranging from $^1/_4$ in. to $1^1/_2$-in. diam. Fasteners and related threaded parts with Hi Tm 9 physical properties are planned in any desired configuration for either tension or shear-load applications.

The SPS break through the thermal barrier—accomplished with a commonly used industrial metal—should soon be duplicated in parts other than fasteners, according to H. Thomas Hallowell, Jr., president of SPS. The prospect is thus good for development of structural and mechanical components of all types with high-temperature properties not previously thought possible.

SPS development work on Hi Tm 9, which included the most extensive elevated-temperature study of fasteners to date, indicates that 1200-F fasteners with equally remarkable, though somewhat lesser strength, will soon be produced, he added.

Hi Tm fasteners may solve the still-unanswered problem of how the proposed piloted aircraft of Mach 3-4 speeds (2100 to 2700 mph) will be held together.

Immediate applications for the bolts are also seen in aircraft engines, power-plant steam and gas turbines, and some nuclear and chemical processes.

Characteristics of EWB Tm 9 Bolts

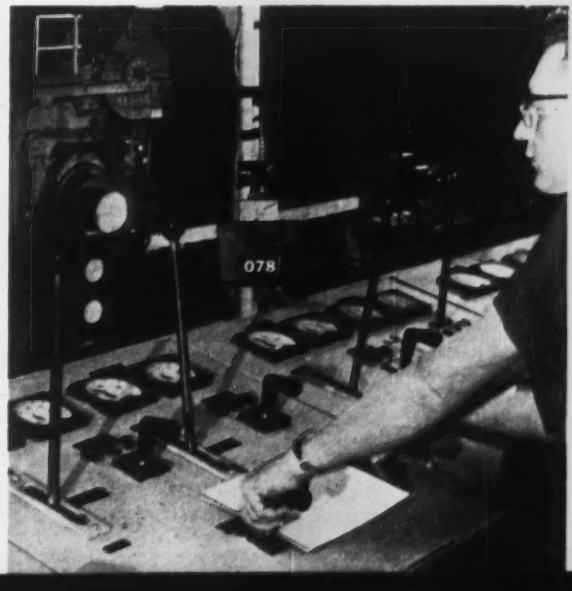
	Room temperature	Tested at room temp after 100-hr soak at 900 F	Tested at 900 F
Ultimate tensile, psi min	220,000	220,000	170,000
Yield strength, psi min	185,000	185,000	140,000
Elongation in 4 diam, per cent min. (specimen)	10	10	16
Reduction of area, per cent min. (specimen)	35	35	50
Shear strength, psi min	140,000	140,000	100,000
Stress rupture, psi for 100 hr life			130,000
Fatigue strength, psi at 8,000,000 cycles, 10 per cent preload	80,000	55,000	80,000
Impact strength (Charpy), ft-lb	18	18	23

X-Ray Thickness Gage

FINISHED steel-strip thickness is determined by means of an x-ray gage installed for field testing and evaluation on the 80-in. strip mill at U. S. Steel's Fairless Works in Fairless Hills, Bucks County, Pa.

The gage operates by measuring the intensity of x rays passing through the steel with a scintillation detector. The intensity is in inverse ratio to the thickness of the steel being rolled. The movements of a nominal-gage-setting wedge and a deviation wedge in the x-ray beam are utilized to maintain constant signals at two different phototube detectors.

With the x-ray thickness gage, a "read-out" located in the speed-control pulpit of U. S. Steel's 80-in. strip mill indicates the gage being rolled. The numbers are translated from the shaft rotations of two dials by an analog-to-digital converter.



The positions of the wedges are translated into strip-thickness units. The wedge positions are transmitted first as shaft rotations by selsyns to a remote location. Two appropriately calibrated dials translate the shaft positions into nominal strip thickness in inches on one dial, and deviations from nominal thickness on the other. In order to read actual gage being rolled, the operator must make a mental calculation summing the two dial readings.

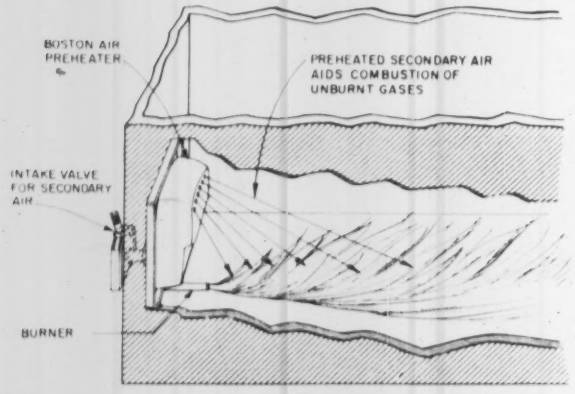
The shaft positions of the two meters are converted into electrical voltages which are then summed, applied to an analog-to-digital converter, and displayed in digital form as a row of three illuminated figures representing actual steel thickness in thousandths of an inch.

Air Preheater Improves Combustion

Fuel savings of up to 25 per cent and a marked reduction in smoke and soot can be obtained with the Boston Air Preheater, recently introduced in the U. S. by The Preheater Corporation of America, New York, N. Y. This low-cost unit, which is usually installed in the fire door of the boiler, supplies preheated secondary air over the fire bed or burners for maximum combustion of the fuel.

The Boston air preheater consists of two basic sections; an adjustable air-intake valve that extends outside of the fire door; and a preheating chamber made from a special heat-absorbing alloy mounted on the inside of the door. The air is drawn through the intake by the normal boiler updraft, circulates through a labyrinth of hot surfaces inside the preheating chamber, and is delivered evenly over the fire bed or burners at over 400 F. The preheating chamber is heated by radiation that would normally be lost, so it consumes none of the fuel energy usable for operating the boiler.

The Boston air preheater is designed for use with low or high-pressure, oil, coal, or coke-fired boilers of the induced-draft, forced-draft, or steam-blast type. During the past 10 yr more than 50,000 of these units have been installed in Europe in apartment houses, commercial buildings, theaters, ships, and industrial plants. Different models are available for all types of boilers.



The Boston air preheater shown in an oil-fired boiler application. Heated by radiation, the preheating chamber heats the incoming secondary air to over 400 F. The heated air helps provide maximum fuel combustion, reduces smoke and soot, and increases the efficiency of heat transfer, with fuel savings of up to 25 per cent.

In normal boiler operation, cold primary air is usually admitted through the primary draft, or introduced through blowers. However, the cold air has two negative effects that prevent it from effecting maximum fuel combustion: (1) Its temperature is too low to cause effective combustion of the unburned gases and volatile matter, and (2) it cools the flame and the heat-transfer surfaces. As a result, extra fuel is required to heat the air, and the unburned hydrocarbons coming into contact with the cooled boiler walls form soot. The Boston air preheater introduces secondary air at temperatures high enough to promote maximum combustion of the unburned carbon monoxide and of the heavier hydrocarbon fractions that linger at the outer edges of the flame and normally settle out as soot or smoke. Introduction of the heated secondary air makes it possible to cut down the intake of fuel-wasting cold primary air. The increased turbulence created by the incoming heated air also aids combustion.

Because the rate of combustion is increased, and the flame is hotter and more luminescent, more heat is transfered to the tubes by radiation rather than by the less efficient conduction or convection methods. This increase in heat-transfer efficiency reduces the amount of heat wasted through the stack with the flue gases. The elimination of soot on the tubes also increases the efficiency of heat transfer. Meanwhile, tubes and joints last longer because they are no longer exposed to radical temperature changes.

The Boston air preheater can usually be installed in one day, without interruption of service. Because the unit has no moving parts outside of minor valve adjustments, it is free from the possibility of breakdown and expensive maintenance.

Nuclear Briefs

▶ New-Type Nuclear Fuel

Ceramic pellets of urania-thoria — UO_2 and ThO_2 — fuel constituents for nuclear reactors, developed at Argonne National Laboratory, Lemont, Ill., are now being used in a Borax series experimental reactor at Argonne's branch at the National Reactor Testing Station near Idaho Falls, Idaho.

Both thorium oxide and uranium oxide have been used in ceramics for many years, but are new as nuclear fuels.

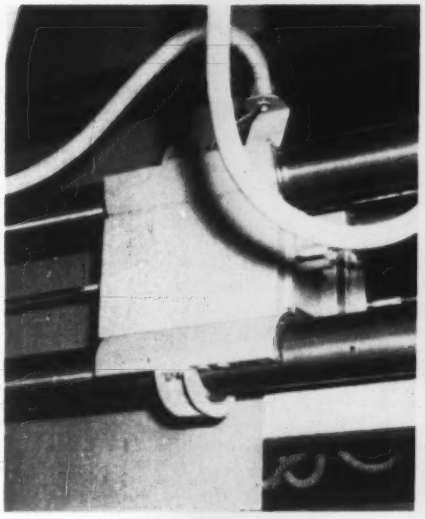
Ceramic fuel elements do not grow and become distorted under intense irradiation, like metallic fuel elements which have been known to double in length.

▶ Sodium Reactor Experiment

Self-sustaining nuclear fission has been achieved in the Sodium Reactor Experiment, a small-scale experimental civilian atomic-power project being developed for the AEC near Los Angeles, Calif., by Atomics International, a division of North American Aviation, Inc.

The SRE is the first sodium-cooled thermal reactor to "produce" a sustained nuclear chain reaction. The SRE uses neutrons moderated with graphite to sustain the fission process, and liquid sodium is circulated through the reactor core to remove heat produced by the atomic fission.

During the initial start-up test, the reactor whose



Beta radiation is being ▶ used by the Armstrong Cork Company to help control weight per unit area of rubber, tile, linoleum, felt backing, and coatings applied to felt backing. The scanning head of the beta gage shown moves back and forth across a moving sheet of material to keep a continuous check on weight per unit area.

Technician at Atomics International, a division of North American Aviation, Inc., tests the ▲ ionization chamber. The device, taller of the two shown, provides information on neutron flux and reactor power. The graphite pile in the background contains a low-level neutron source for test purposes.

design capacity is 20,000 kw of heat operated at a power level of about 1 kw of heat. No electricity was generated.

Following several weeks of testing, the power level of the reactor will be gradually increased, and heat will be purchased to generate about 6500 kw of power on an experimental basis by Southern California Edison Company.

▶ Texas Thermonuclear Research

The Texas Atomic Energy Research Foundation, organized by private utility companies operating in Texas has contracted with the General Atomic Division of General Dynamics Corporation for a 4-yr $10 million privately financed and jointly sponsored research program in the field of controlled thermonuclear reactions.

The thermonuclear research will be carried out at General Atomic's new multimillion-dollar John Jay Hopkins Laboratory for Pure and Applied Science, located at the northern edge of San Diego, Calif. Research work is already under way. The staff of the laboratory now includes more than 150 scientists, engineers, and technicians.

▶ Fleet-Type Nuclear Submarine

The world's first fleet-type nuclear submarine, the *USS Skate*, recently launched at Groton, Conn., will be powered by the third full-scale operating nuclear reactor designed and developed for the U. S. Navy by Westinghouse Electric Corporation.

The *Skate*'s pressurized-water reactor is similar in principle to that of the *Nautilus* but incorporates new concepts and advances in reactor design.

▶ Accident Reports

The AEC has amended its regulation on standards for protection of workers and the public against radiation, to provide that licensees shall promptly notify the Commission of potentially serious accidents involving licensed material.

▶ Beta Gages Control Thickness and Weight

Beta radiation from either strontium-90 or ruthenium-106 is used by the Armstrong Cork Company, Lancaster, Pa., to control the weight per unit area or thickness in the manufacture of linoleum, rubber tile, and felt backing. The beta gages make continuous measurements, and set up automatic controls that make adjustments as often and as quickly as they are needed.

The source of radiation is contained in a small cartridge not much bigger than a thimble, and is mounted on a frame below the material. The end facing the material is open so that radiation is projected through the material. A detector is mounted on a frame on the other side which measures the amount of radiation passing through.

Since the radiation absorbed is directly proportional to the weight or thickness, the gages can be calibrated in the desired terms from samples. Any variation will activate control devices. Other types of gages scan back and forth across the material or make use of backscattering of radiation with both source and detector on the same side.

▶ Nuclear Instrumentation Improvement

A new uncompensated ionization chamber fulfills a need for a simpler and more reliable device for monitoring the power of nuclear research reactors. The mechanism which is encased in lead to reduce gamma-ray interference is already in trial use.

The ionization chamber engineered by Atomics International consists of a small cylinder which contains two graphite electrodes—an inner graphite tube spaced about $1/4$ in. from an outer tube.

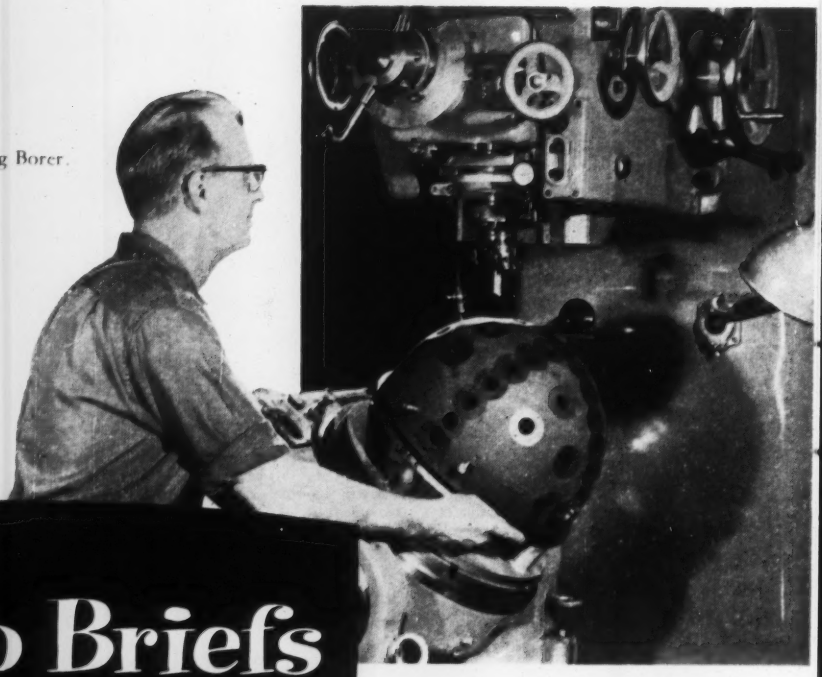
Both tubes are lined with boron-10 on their facing surfaces, making the chamber sensitive to thermal neutrons. The chamber is filled with dry nitrogen gas, thus providing a controlled atmosphere.

As neutron flux increases or decreases in the reactor, the ion density in the sensitive volume between the electrodes does likewise. The indicator attached to the chamber by remote wiring, provides the operator with information on neutron flux and reactor power.

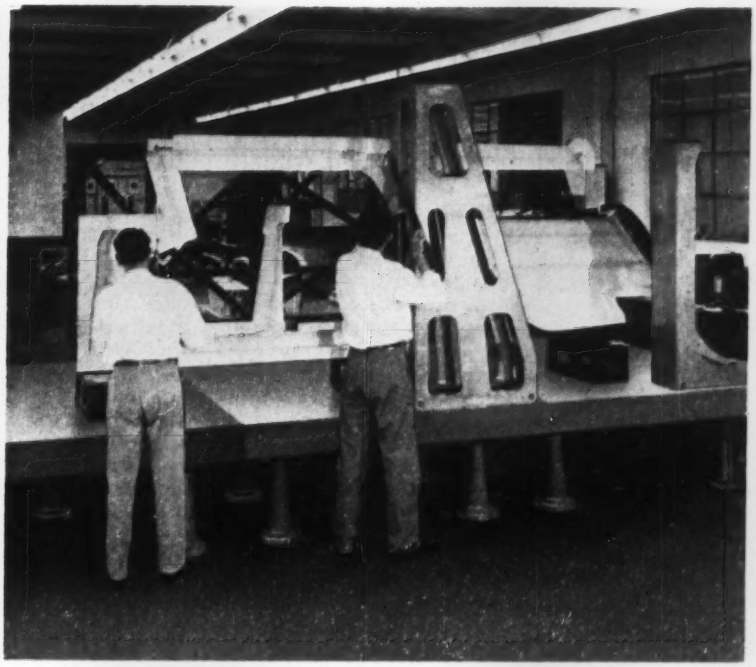
Photo Briefs

Precision "Eyes"

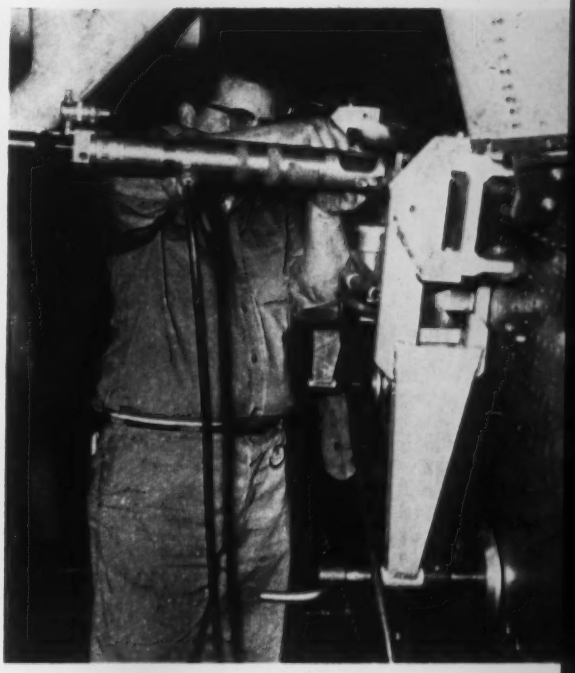
The Hemisphere Sight of the B-52 bomber tail-defense system produced by the Mechanical Division of General Mills, Minneapolis, Minn., is machined on a German-built Lindner Optical Jig Borer. Critical control involves the location and boring of test holes, some to tolerances of +0.0002 and −0.0000, and the milling of a flat surface to within ±2 min for mounting optical lenses.



Giant Sling. A new giant in wire-rope slings, 3 in. in diam and furnished with the patented Dualoc Ending, has been perfected and introduced by the Wire Rope Divisions, American Chain & Cable Company, Inc., Wilkes-Barre, Pa. Recommended for moving heavy power-generating, industrial, marine, and railroad-transportation equipment, it is contrasted with the $\frac{1}{4}$-in. wire-rope sling, smallest made by ACCO.

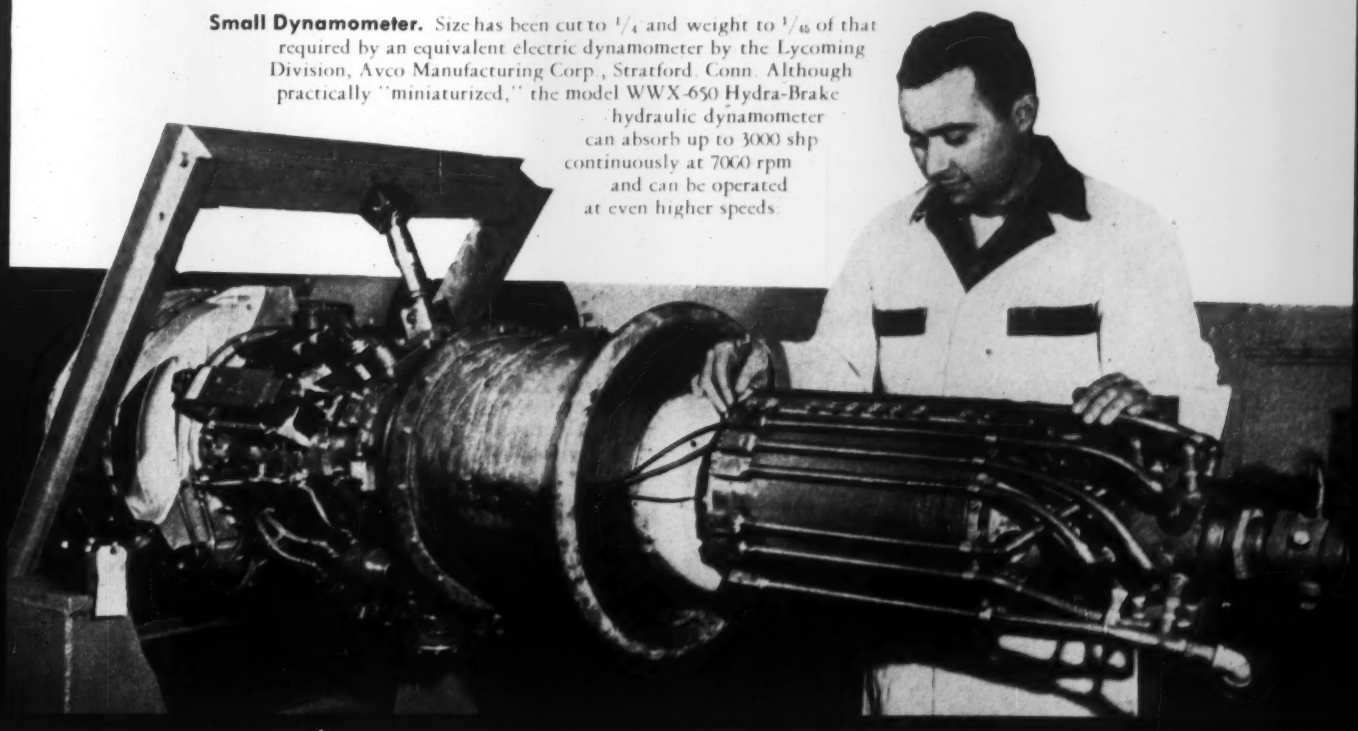


Surface Plate. Plastic-coated surface plates made by Renaud Plastics, Inc., of Lansing, Mich., eliminate the costly grinding and polishing of granite to close tolerances and reduce costs by 50 per cent. Fine-grain granite in the rough is coated with a special plastic which gives a smooth hard surface, accurate within 0.002 TIR of a true plane across corners—well within the required tolerances for steel tools, wood models, patterns, and plastic tooling. The hard surface makes the plate ideal for layout, inspection, or assembly work. It is permanently level, won't warp, swage, rust, or corrode.



Vacuum Assembly for Drilling. Drilling and countersinking properly spaced locating holes for rivets are accomplished by Martin's Baltimore Division with a 3-part vacuum assembly. It consists of: A vacuum plate which holds the apparatus to the skin of the airplane; a slide assembly which moves along a track to position the drill; and clamps at each end. Notches along the lower edge of the bottom track serve as locators.

Small Dynamometer. Size has been cut to $1/4$ and weight to $1/45$ of that required by an equivalent electric dynamometer by the Lycoming Division, Avco Manufacturing Corp., Stratford, Conn. Although practically "miniaturized," the model WWX-650 Hydra-Brake hydraulic dynamometer can absorb up to 3000 shp continuously at 7000 rpm and can be operated at even higher speeds.



European Survey

Engineering Progress in the British Isles and Western Europe

J. Foster Petree,[1] Mem. ASME, *European Correspondent*

The Hanover Fair

THE German Industries Fair at Hanover, held this year from April 28 to May 7, continues to grow in size and importance; and, although it now occupies 21 halls, many of very imposing dimensions, in addition to the open-air section where cranes and other big exhibits are accommodated, this liberal provision of exhibition space is proving inadequate. Plans are well advanced for the construction of a hall, bigger than any existing at present, to house all the electrical exhibits under one roof.

As is usual, many of the exhibits were not mere showpieces, but represented completed contracts for plants; and the number of different countries for which they were destined provided an impressive indication of the extent to which the West German engineering industry is recovering the markets that it had lost during the war.

There are indications in some directions, however, that German manufacturing costs are rising to a point where they are no longer so favorably placed in the matter of price as was the case three or four years ago. They are having to fight harder for their orders, but they are getting them, many from Eastern markets. The quality of the work is generally good, for German engineers have not lost their ingenuity; and so is the salesmanship.

Over-all view of the German Industries Fair at Hanover held April 28–May 7

▶Locomotives for Egypt

IN THE 1956 Hanover Fair the biggest locomotive exhibited was the 4-8-2 + 2-8-4 Beyer-Garratt steam engine (see August, 1956, issue of MECHANICAL ENGINEERING, p. 740) built by the Henschel Maschinenbau G.m.b.H. for Portuguese East Africa.

This year Henschel also showed the biggest locomotive in the Fair, but this time it was one of 13 six-axle diesel-electric locomotives, of Type KK, which they are building for the Egyptian Railways. They are of the standard gage of 4 ft $8\frac{1}{2}$ in. and weigh 132 metric tons in running order. The over-all length is 77 ft, the height is 14 ft 5 in., and the width is 9 ft 4 in. The two 8-cyl two-stroke V-type diesel engines have a maximum speed of 835 rpm and drive d-c shunt-wound generators, which have additional separate excitation. Their combined power output is 1900 hp, giving a maximum speed of 66 mph. The starting tractive effort is 48,500 lb.

The wheel arrangement, according to the Continental notation, is AIA-AIA; that is, there are two three-axle bogies in which, in each case, the center axle is not driven. Each of the other axles has a separate motor, making four in all. The bogies have Flexi-Coil suspension and are constructed of welded steel plates, as also is the underframe.

The body structure of the locomotive consists of the underframe as the lower chord, with two top girders as the upper chord, with lattice-type side framing. The locomotives are being constructed under license from General Motors.

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▶"Hercules of Railway Cranes"

An impressive exhibit on the Krupp stand was the "Hercules of Railway Cranes," as it was termed by the makers, Krupp-Ardelt G.m.b.H., of Hamburg, one of the dozen or so principal firms in the Krupp organization. It is stated to be the most powerful railway breakdown crane yet built in Europe, being capable of lifting 120 tons at a radius of 20 ft, at which radius the large hook can be hoisted to 31 ft above rail level. On the small hook a load of 15 tons can be handled at a radius of just under 50 ft. These lifting capacities are in long tons of 2240 lb, the crane having been built for the New South Wales Government Railways, Australia.

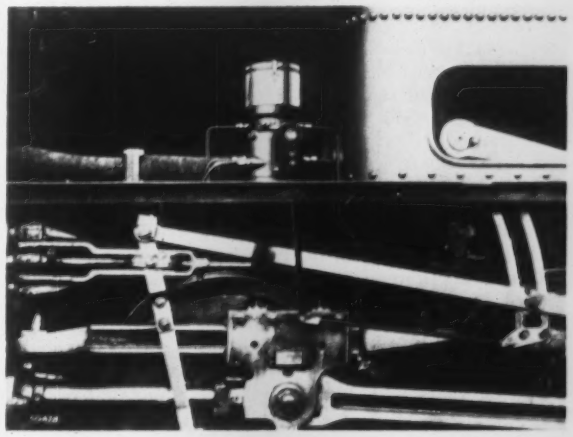
The crane is operated by steam, the hoisting, luffing, and slewing mechanism being driven by two horizontal cylinders, one on each side of the cranehouse, with cranks at 90 deg and fitted with Joy's valve gear. Steam is supplied by a coal-fired boiler, with a heating surface of 269 sq ft, working at 170 psig. The crane is carried on two three-axle bogies, with an axle loading of 20 long tons. Cast-steel cantilever brackets are fitted at the four corners of the frame, with screw jacks at their outer ends, to support the crane for heavy lifts; without them, its lifting capacity is reduced to 18 tons on the main hook and 13 tons on the small hook at 20 ft or 27 ft 6 in. radius, respectively. For heavy lifts, balance weights are fitted under the rear of the revolving platform. When the crane is in transit, these weights are transferred to a flat truck. Including this truck, and the match truck on to which the jib is lowered for transport, the over-all length of the unit is 104 ft. The maximum towing speed is 30 mph.

Hercules of railway cranes. 120-ton breakdown crane lifting 60-ton locomotive. Hanover Fair 1957.

▶Rail and Flange Lubrication

Railway exhibits at the Hanover Fair were not all of such massive proportions as the preceding examples. One of the smaller items shown was a flange lubricator for locomotives, made by De Limon Fluhme & Company, of Düsseldorf, Germany. The principle of the device is that grease is projected through nozzles directly onto the flanges of the leading wheels by means of compressed air, being finely atomized in the process. The grease is drawn from a container on the running board or in some other convenient position by a pump actuated by the valve gear of the locomotive; thus the frequency of operation is a function of the distance run. The usual practice is to give a shot of atomized grease for every 400-ft to 500-ft run along the track. A lime-base high-pressure grease is used, with a dropping point at approximately 210 F, and the consumption is stated to be between 5 and 10 lb per 1000 miles. As the grease is spurted directly against the wheel flange, and only when the locomotive is in motion, it has no opportunity to spread onto the wheel tread or on the rail tread. The makers state that tests on the German Railways have shown that the life of wheels thus lubricated is more than three times that of unlubricated wheels.

Another development by the same firm is a lubricator for crane rails, but in this case the lubricant (oil) is applied to the side of the rail and not to the wheel flange. The appliance consists of two felt wheels mounted on inclined spindles and suspended from the crane carriage at a point above the rail. They are kept in contact with the sides of the rail head by a light tension spring between the spindles. The lower ends of the spindles are hollow and form channels for the supply of oil to the felt, through which it passes, partly by capillary action and partly by centrifugal force, as the wheels roll along the rail. The supply is maintained by some suitable type of multipoint distributor, operated by the travel motion of the crane; thus no oil is expended while the crane is stationary.



Railway wheel flange lubricator made by De Limon Fluhme & Company, Düsseldorf, Germany. Grease container and pump are shown. Grease is projected through nozzles directly onto the flanges of the leading wheels by means of compressed air, being finely atomized in the process.

ASME Technical Digest

Substance in Brief of Papers Presented at ASME Meetings

Railroads

Aluminum in Freight Cars, by C. O. Curell, Kaiser Aluminum & Chemical Sales, Inc., Chicago, Ill. 1957 ASME Railroad Conference paper No. **57—RR-9** (multilithographed; available to Feb. 1, 1958).

ALUMINUM usage in freight cars and component parts is not a recent, nor is it an unusual development. Since the early 1930's, primary metal producers, freight-car manufacturers, and laboratories have been searching for the correct combination of metals, structures, fabricating methods, and joining techniques, to take full advantage of aluminum's light weight, wide range of mechanical properties, and excellent resistance to corrosion, abrasion, and atmospheric weathering.

This experimental aluminum-car program is, at last, beginning to bear fruit; engineers and executives are becoming more aware of the excellent potential that aluminum offers in the greater lading available through lighter weight freight cars, the ease of assembly and operation through lighter weight components, and the improved welding techniques developed in the postwar years.

The development of aluminum-freight-car designs by the mere substitution of aluminum for steel, and governed by conventional steel design practices, will inevitably lead to an inefficient combination of unnecessary weight and costs. Consequently, the significant advantages of the light-weight metal will not be fully realized.

An aluminum structure, to be efficient, must be analyzed and treated as such, from its design inception to its commercial completion.

Unfortunately, some of the early passenger-car applications of aluminum performed unsatisfactorily, since the designers did not have the technical data and the diversified range of alloys, in various forms, from which to choose. Thus an undeserved "bad taste" for aluminum developed and has carried over into the freight-car industry. Sound technical data and open-minded analysis will, in time, dispel the poor impressions created by these previous failures.

This paper describes improved aluminum alloys, fabrication methods, and joining techniques now available for construction of railroad freight cars and components. To be generally acceptable for these applications, the use of aluminum must compare reasonably with structural steel in respect to cost of production equipment, economics of manufacture, and efficiency of operation.

Certain earlier aluminum materials and methods have not fully met these requirements. However, alloys of the weldable, aluminum-magnesium series, joined by advanced welding methods, eliminate many shortcomings encountered in previous usages. Actual service experience had been recorded, illustrating the excellent manufacturing and service characteristics of these improved materials and methods. One economic analysis of an aluminum 90-ton covered-hopper car is presented in this report.

The Expanding Use of Aluminum in Railroad Cars, by G. B. Hauser, Mem. ASME, Aluminum Company of America, New Kensington, Pa. 1957 ASME Railroad Conference paper No. **57—RR-2** (multilithographed; available to Feb. 1, 1958).

THE versatility of aluminum is described and a short history of the use of aluminum in railroad cars is given in this paper.

Several of the aluminum alloys and their various applications in railroads are discussed. For structural applications in passenger cars, alloy 6061 in several heat-treated tempers has been used for rolled and extruded shapes. This is a magnesium-silicide alloy of medium high strength and excellent resistance to atmospheric corrosion. For interior finish applications, the lower-cost, medium-strength alloys are used, such as 3003 for sheets and 6063 for extrusions. For house-type freight cars such as box and refrigerator cars, alloy 6061-T6 is usually used throughout. The same is true of hopper cars, particularly riveted cars. In tank cars, alloy 5052 and 5154 have become fairly standard. These are aluminum-magnesium alloys.

Aluminum-magnesium alloys lend themselves admirably to welded structures. One of the goals of aluminum metallurgists is to produce an alloy which when welded would have strengths comparable to that of welded open-hearth steel.

Tests of welded structures are referred to and briefly summarized. New plant facilities covering sheet and plate, extrusions, and press forgings are described. The new process for "flame" cutting aluminum also is discussed.

Corrosion Prevention of Railroad Cars, by J. W. Crossett, Mem. ASME, The International Nickel Company, New York, N. Y. 1957 ASME Railroad Conference paper No. **57—RR-1** (multilithographed; available to Feb. 1, 1958).

FOR the purposes of this paper, corrosion is defined as the destruction of a metal by chemical or electrochemical reaction with its environment. Corrosion damages cost the railroad industry approximately $410 million per year. Some of the problems contributing to this loss on diesel-electric locomotives, passenger equipment, and freight cars, and remedies to minimize these losses are discussed in this paper.

In the early days of diesel-electric locomotives little consideration was given to engine cooling-water treatment, and it was found that severe deterioration occurred within a few months of operation. The substitution of the alkaline sodium-dichromate-inhibitor treatment eliminated most of the causes of deterioration, but also presented a dermatitis hazard for personnel. In order to combat this problem several railroads are now employing nonchromate inhibitors to prevent corrosion, while others continue to use the chromates and combat the dermatitis problem with educational methods and protective apparel.

Railroad passenger equipment is subject to further problems. It must combat the corrosive elements of all-weather environments in addition to daily dosages of car cleaners which are generally a mixture of sodium-acid sulfate, oxalic acid, wetting agents, and corrosion inhibitors. The use of austenitic steels, while their initial cost is higher, provides increased life and reduced maintenance costs which tend to offset the initial

price differential. In kitchens where salt is one of the major corrosive agents, the use of Monel or copper is suggested for flooring.

Protective surface coatings such as paints, metallic plates, or sprayed metals may also be used to increase corrosion resistance.

Rail Highway Co-Ordination, by N. E. Carlson, Mem. ASME, and J. A. Johnson, Mem. ASME, ACF Industries, Inc., New York, N. Y. 1957 ASME Railroad Conference paper No. **57—RR-7** (multilithographed; available to Feb. 1, 1958).

An analysis of the basic cost of trailer-load shipments by rail, highway, and co-ordinated systems has been made by the authors. Based on recent experience, shippers have discovered additional advantages with piggyback operations. Among the advantages of this operation are dependability and regularity, made possible by freedom from adverse traffic, road, and weather conditions. The economics of freight shipping are presented and a reduction of freight-handling costs is noted as one of its chief economic advantages. An analysis is given of shipment costs. A discussion is also presented of handling equipment and the equipment needed for future operations.

Evaluation of Railway Draft Gears, by W. D. Wallace, Mem. ASME, W. H. Miner, Inc., Chicago, Ill. 1957 ASME Railroad Conference paper No. **57—RR-8** (multilithographed; available to Feb. 1, 1958).

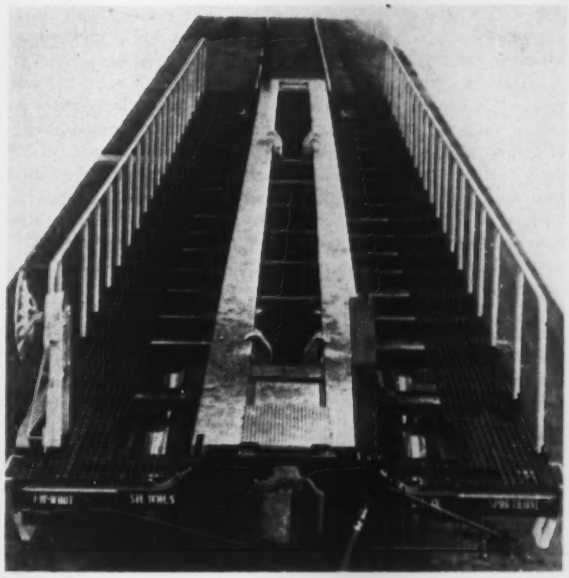
The essential mechanical characteristics of railway draft gears, with particular reference to those designed for freight cars, are presented in this paper. The draft gear operates in a pocket formed between the center sills by the front and rear lug structures, and is harnessed to the coupler by means of a yoke and cross key. The author appraises the characteristics of rubber and friction gears. It is suggested that, by careful selection of draft gears, one original investment can provide high efficiency for minimization of impact shock and full control of long trains at all speeds.

"Roller Freight" Needs Better Trucks, by J. L. Haynes, Mem. ASME, Glen Ellyn, Ill. 1957 ASME Railroad Conference paper No. **57—RR-3** (multilithographed; available to Feb. 1, 1958).

For many years, American railroads have experienced highly satisfactory results from the operation of roller-bearing journal boxes on their passenger cars and diesel locomotives. The program of extending the application of antifriction to the two million freight cars in this country is now being promoted aggressively by some of the leading companies in the industry, and several thousand roller-bearing freight cars are already in service.

There are mechanical problems peculiar to freight cars, owing to the loose side-frame freight trucks, that demand a satisfactory solution if we are to obtain the maximum economic advantage from the roller-bearing journal boxes, comparable with the record established for passenger cars.

This paper gives a comparison of the journal-box applications for railway passenger cars and freight cars. The purpose of this comparison is to emphasize the effect of the truck design on bearing life and performance.



Piggyback, Inc., standard car weighs approximately 50,000 lb, accommodates two trailers per car

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Test Equipment for Use in Diesel Engine Maintenance, by J. A. Smith, New York Central System, Cleveland, Ohio. 1957 ASME Railroad Conference paper No. **57—RR-4** (multilithographed; available to Feb. 1, 1958).

A comprehensive program of testing lubricating oils and fuel oils used in diesel-powered locomotives and in certain auxiliary diesel-powered equipment was formulated by the engineering service department of the New York Central System.

Eight oil-test stations were established throughout the system in order to determine the condition of the lubricating oil. Each station is equipped to make the following tests on oil samples taken from the crank case: flash test, precipitation number, and ash. In the event that one or more of the tests indicates that corrective action is necessary, the test station operator is authorized to request the proper action be taken before the unit is placed in service. In so far as it is possible, typical critical conditions have been codified and the operator has been instructed in the interpretation of the data.

A sixteen-channel direct reading spectrometer is available for analysis of the ash, and an electron microscope is used for analysis of fuel oils and lubricating oils. The spectrometer, the electron microscope, and the oil-test stations cost approximately $75 thousand. This capital investment has been amortized in the past two years by the number of potential engine failures which were averted by the reduction in the amount of lubricating oil purchased, and by the economics realized in the fuel-procurement program.

The Use of Economy Fuels on Diesel Locomotives, by R. McBrian, Mem. ASME, Denver & Rio Grande Western Railroad Company, Denver, Colo. 1957 ASME Railroad Conference paper No. **57—RR-6** (multilithographed; available to Feb. 1, 1958).

The Denver & Rio Grande Western Railroad has reduced operating costs for the past four and one half years by satis-

factorily burning "economy fuels." An economy fuel is defined as any fuel which can be purchased at prices below established market prices for definite grade or specification fuels; such fuels to be purchased without a railroad specification and which will not result with usage in undue increased maintenance or operational problems and costs. This paper points out that it is possible to secure savings through the use of various types of economy fuels. However, to do so requires a full study in the laboratory, in test engines, and in road service tests, in order to evaluate and condition the economy fuel properly.

The description and results of tests on economy fuels are presented in this paper.

Oil and Gas Power

A Study of Industrial-Engine Operation, by H. E. Fisher, Tennessee Gas Transmission Company, Houston, Texas, and V. H. Miles, Assoc. Mem. ASME, Sperry Gyroscope Company, Great Neck, N. Y. 1957 ASME Oil and Gas Power Conference paper No. **57—OGP-3** (multilithographed; available to March 1, 1958).

In the past few years compression pressures have risen from about 125 psi to approximately 300 psi. These changes have been very attractive and have lowered fuel consumption in some cases as much as 25 per cent and increased power output up to 40 per cent.

These gains also have presented operating problems. The operators have been expected to keep industrial gas engines at peak efficiencies with the same instrumentation that has always been used. The tools, basically, consist of a timing light and a spring-loaded piston-type pressure indicator.

As a result of studies made with the Tennessee Gas Transmission Company and several other companies, it was recognized that there was a need for an analyzer similar to the aircraft-engine analyzer that has long been used by the aircraft industry. Studies showed that a suitable analyzer for industrial engines should include ignition, vibration, and pressure analysis.

The analyzer which has been developed to satisfy these requirements is described in this paper.

Field acceptance of the analyzer has been excellent. Operators and mechanics can co-ordinate quickly their knowledge and past experience on engines with the information which the analyzer provides. They can see unlimited applications for this type of maintenance tool.

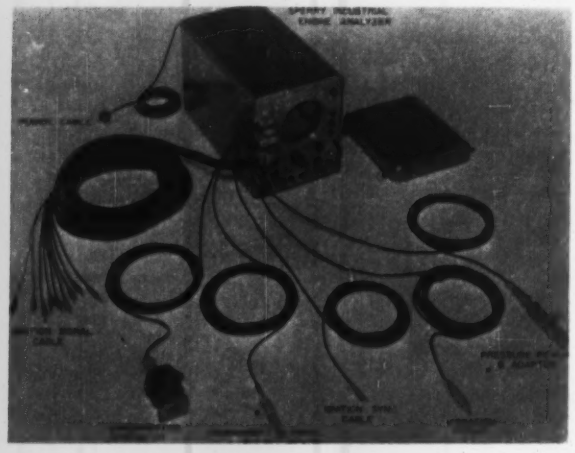
With an instrument such as the industrial-engine analyzer, the industrial-engine operator has a tool which can decrease downtime materially, prevent needless maintenance, and help to operate engines at peak efficiency.

The Use of Heavy Fuel in High-Speed Diesel Engines on River Towboats, by E. Renshaw and R. N. Larson, St. Louis Shipbuilding & Steel Company, St. Louis, Mo. 1957 ASME Oil and Gas Power Conference paper No. **57—OGP-10** (multilithographed; available to March 1, 1958).

The use of heavy residual fuel oils in diesel engines dates back as far as the invention of Dr. Diesel. Historically, the differential in price of about one to two between heavy residual fuel and lighter distillate diesel fuel has been the motivation for using residual fuels in thousands of marine and stationary installations both here and in Europe.

It has been common practice for many years to operate large slow-speed marine and stationary diesel engines (especially those of European design) on heavy fuels of various viscosities. In such installations for starting up, shutting down, and for maneuvering under part load, distillate fuels have been used in many instances. This practice in the shipping industry has resulted in satisfactory and economical operation, and at present the majority of commercial motor vessels throughout the world are using residual fuels in their diesel engines. However, all studies have indicated that up to now it was inadvisable to operate high-speed diesel engines on residual fuels even when distillate fuel was used at part load, because of engine deposits, excessive wear, and poor engine performance.

Extensive research in the field over the years has continually improved the application. But up to now there have been many serious limitations which precluded many diesel engine operators from taking advantage of the inherent savings. The authors of this paper believe that "vapor phase" cooling, by maintaining high engine heat, by maintaining the same temperature throughout the engine, and by furnishing heating steam at no cost, is the prime factor in permitting the successful and economical burning of residual fuel in high-speed engines. Based on their experience, for a 3600-hp towboat the cost of a heavy-fuel installation, including the vapor-phase equipment, Nemec unit, centrifuge and piping, can be paid off in one year from the savings of the difference in cost between residual fuel and distillate fuel.



Industrial-engine analyzer system. The system provides analysis of ignition, vibration, and pressure of industrial engines.

Gas Pulsations—The Problem, Southern Gas Association's Approach, and Results, by E. N. Henderson, Arkansas Louisiana Gas Company, Shreveport, La. 1957 ASME Oil and Gas Power Conference paper No. **57—OGP-9** (multilithographed; available to March 1, 1958).

In a reciprocating natural-gas compressor station, pulsations in the compressor and piping system are caused, and their characteristics determined, by a great many factors beginning with the alternating intake and discharge of gas by a compressor cylinder. Some other major factors involved in pulsation causation are the compressor cylinder configuration, including clearances, the number of cylinders on a given unit together with the crank-angle relationship of the in-

dividual cylinders, and individual piping components such as nozzles, volume bottles, lateral lines, and yard piping.

The cause of gas pulsation lies within the system as a whole and is not governed by any individual component to the exclusion of other components.

This definition of the cause of gas pulsation was not possible prior to the Southern Gas Association's Pulsation Research Project.

The results of the project's approach are presented in this paper in terms of facilities and techniques developed together with the practical application of these results. References are made to more detailed technical articles or papers that have been presented on specific phases of these developments. Membership in the Pulsation Research Council is available to all operating companies including nonmembers of the Southern Gas Association.

Chromium Plating Development at the U. S. Naval Engineering Experiment Station, by R. W. Reynolds, U. S. Naval Engineering Experiment Station, Annapolis, Md. 1957 ASME Oil and Gas Power Conference paper No. **57—OGP-6** (multilithographed, available to March 1, 1958).

THE severity of operation on new designs of diesel engines is continually increasing as a result of higher unit loadings with greater output per pound of engine. In many cases, this has necessitated the use of steel cylinder liners in place of the conventional cast iron. To insure that past standards of reliability and service life are maintained, the surface of the steel liners must have resistance to both abrasive wear and corrosion. The best known means of accomplishing this is to use porous chromium plating on the wearing surfaces.

The progress of the U. S. Naval Engineering Experiment Station's chromium-plating development is described in this paper. Early tests showed the greater wear resistance of porous chromium over that of cast-iron diesel cylinders. The tests showed a wide variation in wear resistance of the chromium used. An accelerated wear test machine and a plating plant were built with laboratory-type controls to plate specimens and evaluate the effects of plating factors on the wear resistance of chromium. The machine is also used to evaluate chromium as prepared by commercial platers. During the investigation, two types of Engineering Experiment Station porous chromium plating over steel have been discovered that are superior in wear resistance, based on wear-machine tests, to commercial porous chromium-plated samples over steel presently submitted. Engine tests are planned for these best types. The work is to continue in exploring other types and to solve problems in addition to wear.

A Practical EnginScope for Field Maintenance, by E. Eugene Ecklund, Allen B. DuMont Laboratories, Inc., Clifton, N. J. 1957 ASME Oil and Gas Power Conference paper No. **57—OGP-7** (multilithographed, available to March 1, 1958).

ECONOMICAL and efficient operation of a spark-ignited internal-combustion engine is primarily dependent on proper ignition. Regardless of component physical characteristics and location, the electrical characteristics are fundamentally the same. Viewing the wave form on a cathode-ray oscilloscope is a basic testing technique.

The cathode-ray oscilloscope is a basic indicating device. It draws a visual picture in graph form, displaying voltage in the vertical *Y*-axis, and time in the horizontal *X*-axis. Hence it can display any phenomenon which is, or can be, converted to electrical energy. A multitude of transducers are available to allow measurement or indication of pressure, vacuum, vibration, motion, displacement, velocity, acceleration, stress and strain, temperature, light, and other similar phenomena.

By a unique approach based on a desire for simplicity of application, the DuMont EnginScope has permitted utilization by the average mechanic. Simple attachment, portability, and a unique multiline presentation (one per cylinder) allow isolation of trouble by comparing one cylinder to the others. All outputs from a single distributor are shown simultaneously in detail. By use of a grid-marking technique, the source of trouble can be located. Troubles can be detected prior to giving operating difficulties, allowing work to be carried out on a preventative basis.

Variations in Marine-Engine Performance, by F. C. Vibrans, Philip S. Spaulding and Associates, Seattle, Wash. 1957 ASME Oil and Gas Power Conference paper No. **57—OGP-2** (multilithographed, available to March 1, 1958).

THIS paper deals with the performance of a marine engine operating at full throttle when the driven vessel changes speed due to some outside force, such as the addition of a tow or entry into shallow water. It describes the variation of propeller torque and rpm as functions of speed through the water. Included also are the functions of torque and power versus rpm with speed through water held constant. It discusses the application of these functions in two examples. One applies to the effect of a tow, and the other to the effect of the usual variation in effective horsepower met in service. Finally, it suggests a criterion for operating marine engines at full throttle in service to keep torque and rpm within the limits set by the machinery manufacturer.

Sizing of Centrifugal Separators for Residual Fuels, by Kurt Froelich, Mem. ASME, Nordberg Manufacturing Company, Milwaukee, Wis. 1957 ASME Oil and Gas Power Conference paper No. **57—OGP-8** (multilithographed, available to March 1, 1958).

TUBULAR-BOWL-TYPE and disk-bowl-type centrifuges can be applied to batch-type treatment of residual fuels. There are also self-cleaning centrifuges for continuous cleaning. They are used in parallel operation (single pass) and in series, with the second stage possibly used only for removing solids (clarifier).

One of the problems arising through the application of centrifuges is to install the proper capacity initially. This is evident because centrifuges, on the one hand, are the most expensive item in the installation of a treatment system for residual fuels, and, on the other hand, they may be quite inefficient if undersized. Some of the items which may influence the decision upon number and type of centrifuges are discussed in the paper. The final comparison should be made by actually testing the centrifuge, but a preliminary comparison can be made theoretically.

An Appraisal of Compressor-Cylinder Cooling Requirements, by W. F. May, Mem. ASME, and A. G. Clark, Mem. ASME, Ingersoll-Rand Company, Painted Post, N. Y. 1957 ASME Oil and Gas Power Conference paper No. **57—OGP-1** (multilithographed, available to March 1, 1958).

A DISCUSSION of the cooling requirements of reciprocating-compressor cylinders under various operating conditions is presented in this paper. Particular emphasis is placed on compressors of 100 hp or more having cylinders of double-acting construction. Many of the observations, however, will apply equally well to smaller compressors having either single-acting or double-acting cylinders.

The process of compressing air or gas in a reciprocating compressor may generate a considerable amount of heat. In many cases, particularly those involv-

ing high compression ratios, this heat of compression, plus the heat of friction generated by the piston rings and piston-rod packing, causes undesirably high operating temperatures.

Reducing the operating-temperature levels of both the air or gas handled and the cylinder itself, through cooling, offers many advantages. The main advantages of removing as much heat as possible are that lubrication is improved, maintenance costs are reduced, and the horsepower required to compress a given amount of gas is reduced.

The purpose of adding a water jacket to a compressor cylinder is to remove a portion of the heat of compression and heat of friction. This paper attempts to evaluate the factors affecting cylinder cooling and to show how to judge whether or not water-jacketing is necessary.

Turbocharging Development for Loop-Scavenged Two-Cycle Gas Engines, by J. D. Hines, Mem. ASME, and N. Reed, The Cooper-Bessemer Corporation, Mt. Vernon, Ohio. 1957 ASME Oil and Gas Power Conference paper No. **57—OGP-4** (multilithographed; available to March 1, 1958).

METHODS of adapting exhaust turbochargers to ported loop-scavenged two-cycle gas engines are discussed in this paper.

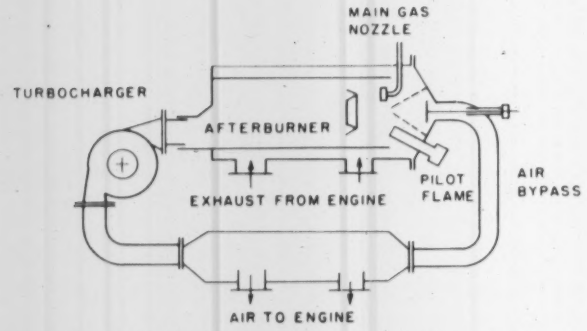
Two methods of turbocharging, constant pressure, and pulse system, were considered. Development work on four-cycle engines had been with the pulse system, which by its characteristics delivered sufficient power to deliver air for starting and light-load operation. Under certain conditions, however, this system may produce a pressure in the exhaust system which is detrimental to scavenging of two-cycle engines. Constant-pressure turbocharging, on the other hand, obtains less restriction to the flow of exhaust gas, but the characteristics of this system are such that exhaust energy is inadequate for starting and light-load operation. The unit, therefore, is not self-sustaining until an approximate $^5/_8$ load is carried by the engine.

These considerations led to the study of three principles of turbocharging: straight turbocharging, parallel operation with piston-type scavenging pumps, and series operation with centrifugal blowers. The design assumptions and premises used for each type were proved or disproved, and the results are reported.

Effect of Intake Combustion-Air Conditioning on Performance of Spark Ignition Gas Engines, by W. F. MacInnes and R. L. Solnick, Assoc. Mem. ASME, Fluor Corporation, Whittier, Calif. 1957 ASME Oil and Gas Power Conference paper No. **57—OGP-5** (multilithographed; available to March 1, 1958).

THE effects of intake-air temperature on the knock-limited performance of a spark-ignition stationary-type gas engine were evaluated. It was found that the knock-limited power output of the test engine increased with reduced intake-air temperatures, but was somewhat more sensitive to absolute humidity changes. The increase in knock-limited power, however, which is allowed at high absolute humidities, is accompanied by increases in exhaust-gas temperature and specific fuel consumption.

Audible disturbances associated with knock were correlated with the combustion pressure time diagram, and a technique for determination of the knock limit was developed. Results of the tests are presented in the form of graphs relating power output and specific fuel consumption to intake-air temperature and humidity. Some discussion of the results as related to those of previous investigations also is included.



Two-cycle engine turbocharging with afterburner assist is used to eliminate the back-pressure trouble expected with ported-loop scavenged two-cycle gas engines

Wood Industries

Selection of Carbide-Tipped Saw Blades for Optimum Performance, by E. J. Dower and W. E. Oakey, Mem. ASME, Southwest Research Institute, San Antonio, Texas. 1957 ASME Wood Industries Conference paper No. **57—WDI-9** (multilithographed; available to March 1, 1958).

THE purpose of this paper is to set forth the relationship of the many variables in the operation of wood sawing with circular blades, and to present a method of handling these variables to establish optimum performance. Included is a limited amount of test data on carbide-tipped blades and examples of certain fundamental relationships which become apparent.

This paper shows that in sawing with carbide-tipped blades, the bite per tooth bears a definite relationship to sawing energy and sawn finish. Tests were made to determine the maximum allowable bite per tooth which would produce various finishes, and to determine the energy requirements for various sizes of bite per tooth. Based on the results of these tests, a method is proposed for the selection of optimum blades for various requirements and operating conditions. Because the bite per tooth is a function of blade speed, feed rate, and number of teeth, any one of several different combinations of these variables can be selected, depending on blades available, and the spindle speeds and power of the machine.

Automatic Machining in Furniture Manufacture, by E. S. Johnson, Mem. ASME, North Carolina State College, Raleigh, N. C. 1957 ASME Wood Industries Conference paper No. **57—WDI-8** (multilithographed; available to March 1, 1958).

AUTOMATIC machining in a furniture factory does not exist today, but there are indications that such a procedure will be practical in the foreseeable future. In this paper, automatic machining is defined as a process in which all operations are performed in sequence on rough-dimension wood parts with mechanical handling and feeding, and in which tools are reset automatically when electronically requested by a feedback system actuated by gages automatically measuring the parts after they are machined.

This paper reviews briefly the history of mechanization in some phases of wood-furniture manufacture. Special attention is paid to mechanization and mechanical handling in machining parts after they have been cut to rough length, width, and thickness in the rough mill.

Present developments in machining are covered. Specific examples of current practices are listed and some trends toward progress in automation are discussed.

Core Materials for Plywood—Standard Lumber Cores, by C. D. Dosker and S. H. Durst, Gamble Brothers, Inc., Louisville, Ky. 1957 ASME Wood Industries Conference paper No. **57—WDI-10** (multilithographed; available to March 1, 1958).

LUMBER is still the standard material for use in plywood core stock for furniture and cabinet manufacture. Unfortunately, too little attention has been given to the importance of the proper selection of the type of core and the species of lumber that would give the best results. In considering foundation materials one must think in terms of the end use and the type of exposure required. It is suggested that new materials be judged by cost and performance in comparison to lumber.

Paper Honeycomb Used for Core Materials at the Brunswick Balke Collender Company, by R. A. McKay, The Brunswick Balke Collender Company, Marion, Va. 1957 ASME Wood Industries Conference paper No. **57—WDI-4** (multilithographed; available to March 1, 1958).

THE basic principle of producing paper honeycomb is that of "blowing up" a certain quantity of paper to yield a much larger volume of low-density cellular structure.

A wide range of properties may be obtained in paper honeycomb by varying the caliper of the paper, the size of the cells, and the percentage of resin impregnation.

The author's company uses paper honeycomb for core stock in 19 basic panels of which nine are for table and desk tops and ten for various cabinets. This small group of panels is in turn used to make up over 150 different sales items. New uses for paper honeycomb are being continually studied and tested.

The panels currently being constructed fall into two classes: those of three-ply construction having skins of $^1/_8$-in. hardboard, and those of five-ply construction having skins of either $^1/_4$-in. sycamore plywood or $^1/_8$-in. and $^1/_4$-in. hardboard and face and back of plastic.

A general report covering the production of paper honeycomb, its use as core stock for school furniture panels, and suggestions to prospective users of paper honeycomb as core stock is given in this paper.

The Case for the Hollow Core, by R. Casselman, Washington Door Co., Washington, N. J. 1957 ASME Wood Industries Conference paper No. **57—WDI-7** (multilithographed; available to March 1, 1958).

THE definition of hollow cores in wood panels or doors in this paper is limited to those comprising relatively large spaces or cells separated or bounded by elements perpendicular to the faces and large and strong enough in bulk to occupy only a small fraction of the core's volume.

Hollow-core materials have the following advantages: they are economical, workable, fast handling, convenient form and size, available, low in bulk, light in weight, gluable, stable, strong, compressible, adequate in gluing area, and temperature resistant.

Chipboard, the Superior Plywood-Core Material, by P. F. Brusquini, Granite Board, Inc., Goffstown, N. H. 1957 ASME Wood Industries Conference paper No. **57—WDI-5** (multilithographed, available to March 1, 1958).

THE manufacture of chipboard consists of the blending and pressing of three components: wood chips, synthetic resins, and some type of the many waxes that are available. The definition of the word "chip" is very broad. It specifies no particular particle size, yet a very important point in the manufacture of chipboard is particle size and geometry.

Chipboard manufacture is divided into two major methods of production—the extrusion process and the platen-press method. The former consists of forcing the raw material, prepared and blended wood glue, through a heated constriction-type metal die. The size and character of the extrusion die will determine the cross-sectional appearance of the chipboard produced. This may be solid or have some symmetrical voids for some specific product application.

The platen-press method subjects the same raw material to heated platen pressures which are perpendicular to the flat faces of the finished chipboard. It is with the platen-press method that this paper deals: the production of the chipboard, its characteristics and application as a plywood-core material, and the advantages and savings by its use over other accepted core materials.

Finishing Controls at Drexel Furniture Company, by N. C. Hatcher, Jr., Drexel Furniture Company, Drexel, N. C. 1957 ASME Wood Industries Conference paper No. **57—WDI-1** (multilithographed; available to March 1, 1958).

WOOD finishing, once regarded as an art, is fast becoming a technical profession. The influence of automation in finishing departments has increased production capabilities and provided better and more consistent quality. Technical advances during the past quarter century have greatly improved the durability and light-fast qualities of finished wood.

The wood-furniture industry in most instances relies on the finishing material suppliers to style and give technical directions during the finishing process. The author's company has established its own finishing department responsible for these functions.

Through the use of a finish-testing laboratory, furniture manufacturers can select the best material for a given job and satisfy themselves that each batch of material purchased will meet the tolerance-range requirements set forth in color consistency, physical properties, and all other characteristics.

Aviation

A Fresh Approach to Aircraft Landing-Gear Design, by R. O. Dickinson, Jr., Lockheed Aircraft Corporation, Marietta, Ga. 1957 ASME Semi-Annual Meeting paper No. **57—SA-30** (multilithographed, available to April 1, 1958).

THIS paper reviews the development and design of the landing gear for the Lockheed C-130 airplane.

The basic requirements established by the Air Force for this design were the following:

1 Design compliance with established military specifications and requirements.
2 Airplane gross weight of approximately 100,000 lb.
3 Capability of operation from soft fields or hastily prepared runways, surfaced with sand, sod, brush and weeds, small rocks and gravel, or steel landing mats.
4 Low maintenance requirements with ease of maintenance when required.
5 Simplicity of design and operation.
6 Reliability.

To determine how the landing gear was to be attached to the airplane, several other design requirements of the C-130 were reviewed. If the gear were to be attached to the wing, an extremely long flexible gear, prohibitive in weight, would be required because of the high wing. Also, wing fuel tanks require all available space in the wings and leave no place for the gear.

The C-130's prop-jet engines have a small over-all diameter nacelle and large centrally located exhausts, thereby eliminating the nacelles as points of

attachment because of excessive heat and lack of space.

A review of these factors indicated that the gear would have to be attached to the fuselage, necessitating a narrower tread than approved by applicable military specifications. However, the low landing speed permitted a narrower tread and allowed the approval of a deviation from the specification. Another advantage of a narrow tread is a shorter ground turn radius facilitating the use of narrow landing strips. The turning radius is dependent upon the distance of the gear from the center line of the airplane, provided that the nose gear steering or turning angle is commensurate with the main gear turning radius. In the C-130 the short turn radius can be attained by some scrubbing (sideways motion) of the nose gear.

This gear is unique in that it is a narrow tread gear retracting within the contour of the fuselage. A short discussion of the problems encountered, their solutions, and a description of the present operational C-130 gear are included.

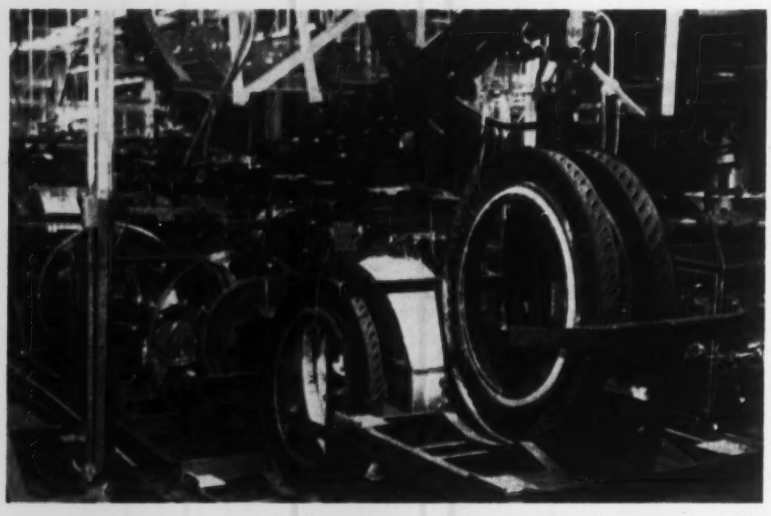
Automation and New Methods for Overhaul, by E. W. Denison, General Electric Company, Cincinnati, Ohio. 1957 ASME Semi-Annual Meeting paper No. 57—SA-15 (multilithographed, available to April 1, 1958).

The Aircraft Gas Turbine Division of the General Electric Company has found that automation is a major factor in the solution of ever-increasing problems encountered in the overhaul of jet engines.

The problems in overhaul, though not unique in most instances, are many and varied. The two basic considerations in applying progressive mechanization to any operation are volume and the nature of the product. The problem with volume is no greater in the area of overhaul than in any other industry, but the nature of the product is unique and is derived from the following facts: (*a*) No two engines sent in for overhaul have the same faults to the same degree; (*b*) no two engines have the same number of running hours; (*c*) parts differ greatly from model to model. These facts greatly complicate the manufacturing cycle, rework procedures, and accumulation for assembly.

Today, automation is in operation or being developed in General Electric's overhaul areas of cleaning, degreasing, inspection, bearing processing, removal of nozzle-diaphragm partitions, extraction of stator-ring and blade assemblies, painting, materials handling, and material flow. Studies were made before starting this program; all indicated many production and manufacturing problems.

The Cleaning Methods Used in the Overhaul of Aircraft Gas-Turbine Power Plants, by J. L. McCabe, General Electric Company, Cincinnati, Ohio. 1957 ASME Semi-Annual Meeting paper No. 57—SA-17 (multilithographed, available to April 1, 1958).



Automatic pickup on powered, overhead conveyer, moving parts through the chemical cleaning system at General Electric Company's Aircraft Gas Turbine Division

Cleaning processes for overhauled engines and parts are described in this paper.

A successful engine-overhaul program must incorporate an efficient cleaning system, capable of removing the large variety of soils, organic deposits, paint films, and oxidized heat scales which accumulate as a result of engine operations in field service.

The cleaning system must be versatile. It must be designed to accommodate the wide range of ferrous or nonferrous metals and organic coatings which make up the component parts of turbojet-engine construction.

In addition, the cleaning system must be thorough. It must remove surface contaminants to the extent that visual, magnetic-particle, and fluorescent-penetrant inspections can be performed for the detection of rejectable defects.

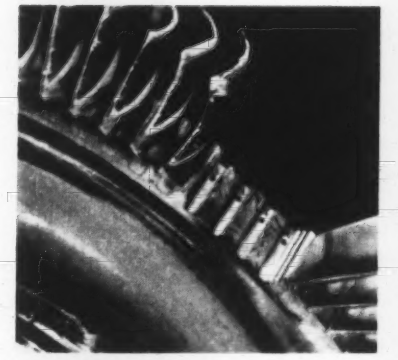
At the same time, the chemical solutions used must not adversely attack metals from which the parts are made. Such action could result in a loss of dimensions, surface corrosion, and subsurface attack which eventually could induce failure in service. The evaluation of these factors requires extensive laboratory facilities and competent personnel.

The Mechanical Approach to Simplified Jet-Engine Maintenance, by L. A. Wilson, Bureau of Aeronautics, Department of the Navy, Washington, D. C. 1957 ASME Semi-Annual Meeting paper No. 57—SA-37 (multilithographed, available to April 1, 1958).

The sources of major problems resulting in accidents or forced landings now encountered with turbojet engines, in order of the frequency of their occurrence are: Fuel leaks, fire explosion, flameout; fuel control and pump; turbine; compressor; and lubrication, bearings, and such.

The maintenance of turbojet engines is becoming more difficult because of the increasing complexity of the engines and their accessories. Because of the shortage of skilled technicians and the continued emphasis placed upon national defense, it is imperative that new tools and methods be developed for the purpose of simplifying our present maintenance procedures.

Perhaps many of our routine tests of engine accessories can be simplified by better utilization of the methods of automation. A suggested example of an automatic fuel control test stand has been described. Although such methods will not replace entirely the human



Example of turbine-wheel failure caused by thermal fatigue as a result of operating a jet engine 25 C above the specified temperature

operator, they could relieve him of much routine work such as the setting of test conditions and the recording of data. Thus the tests procedures could be accelerated considerably.

Another problem concerning the evaluation of a turbojet engine installed on an aircraft has been discussed. This is especially important as approximately 90 per cent of our engines must now be removed from service before achieving high-time because of failure or undetermined causes of malfunctioning. At the present time, analysis of an engine installed on an aircraft is based on the know-how of the line mechanic supplemented by the conventional instrumentation of the aircraft. It is believed that this procedure can be simplified and made more accurate by using an engine analyzer designed specifically for this purpose.

Metallic Material Engineering and Manufacturing Aspects of New High-Speed Aircraft, by E. A. Simkovich, Republic Aviation Corporation, Farmingdale, N. Y. 1957 ASME Semi-Annual Meeting paper No. **57—SA-40** (multilithographed, available to April 1, 1958).

THE "bit-and-piece" method of manufacturing and assembling aircraft structures is reaching a point of diminishing returns. The use of large integral subassemblies and structures such as castings, forgings, and honeycomb, joined together by flash-welding and/or a minimum of fasteners appears to be applicable in the great majority of cases. All these new developments point to the absolute necessity for intensive correlated evaluation and selection of materials from both engineering and manufacturing viewpoints. The basic airframe shell is more complex than ever, adequate materials planning in the preliminary design stages can do much to insure the development of an optimum, efficient weapon.

There are certain general desirable characteristics which a metallic material must possess in order to be utilized efficiently and provide an optimum structural framework for a high-speed weapons system of the aircraft type.

1 Good properties on a strength-weight basis at high temperatures; these properties must be retained after long-time stressed and unstressed exposure. A reasonable degree of ductility at the operating temperature is also essential.

2 Properties of the alloy in the as-received or heat-treated states must be uniform to permit designing to small margins of safety and to permit ease of fabrication on a production basis. Coupled with this is the necessity for flatness and low-gage variation (if the product is basically sheet or plate). Excessive or continued variation above nominal gages can impose a staggering weight penalty.

3 The alloy must be adaptable to large-scale shop manufacture. Delicately balanced-alloys (in so far as slight variations in heat-treatment temperatures lead to wide property changes are concerned) are undesirable. Inconsistent response to large forming deformations, poor machinability, the necessity for elaborate shop process controls are also undesirable characteristics.

The Mechanical Design Approach to Simplified Maintenance, by G. W. Cameron and J. W. Rupp, Douglas Aircraft Company, Santa Monica, Calif. 1957 ASME Semi-Annual Meeting paper No. **57—SA-36** (multilithographed, available to April 1, 1958).

RELIABILITY of equipment is essential for efficiently conducting a planned maintenance program. For those who are involved in aircraft-component design, development, or maintenance, some methods that have been used successfully to achieve reliability of component operation are given.

Some necessary qualifications for efficient maintenance are presented. They are:

1 The initial product design must include simplicity and provide for proper maintenance.

2 The product must be reliable to the extent of completing an established service period in order to schedule maintenance efficiently.

After being actively engaged for a number of years in a service test type of development program for rotating machinery, several methods of achieving functional reliability have become evident:

1 Improve the design by changing the capacity or function of detail working parts.

2 Increase the inspection program to insure that only "blue-print" parts are used.

3 Initiate and continue a full-time development program until the desired reliability is achieved.

4 Maintain close co-operation between the engineering department, the product service overhaul department, and the operator.

Advantages that result from continued engineering development to perfect a product are:

1 Definite improvement of product reliability and extended life of operation are achieved.

2 Costs are reduced for both manufacturer-overhauler and customer.

3 Knowledge is gained by the manufacturer that can be applied in future design work.

4 The customer is satisfied due to having a better product and because of the active manufacturer's interest in the customer's welfare.

5 Inexperienced engineering personnel in the manufacturer's employ have an opportunity to learn about the product while fulfilling a necessary task in the project.

An Approach to Simplification of Aerial Refueling Hose-Reel Units, by W. F. Whitesides, Flight Refueling, Inc., Baltimore, Md. 1957 ASME Semi-Annual Meeting paper No. **57—SA-47** (multilithographed, available to April 1, 1958).

THIS paper deals with an organized approach to simplification of flight refueling hose-reel units. With the primary goal of new drive systems to be studied, this writing reviews the different organized phases from the initial analysis to the prototype and production models, including the results of the analog computer studies conducted to provide data on the magnitude of certain design variables necessary for adequate reel response in several different type drive systems. Reasons for the undertaking of this challenge are considered, the fundamental design objectives and operating principles of the two best systems are presented and reviewed with culmination

in the development of a simple, compact, and reliable prototype unit.

Machine Design

Mechanical Problems Involved in Short Circuits on Core-Form Power-Transformer Coils, by E. W. Tipton, Westinghouse Electric Corporation, Sharon, Pa. 1957 ASME Semi-Annual Meeting paper No. **57—SA-46** (multilithographed; available to April 1, 1958).

MODERN power transformers are being subjected to more frequent and to more severe short circuits than they were in years past. Under short circuit the windings are subjected to severe mechanical stresses, but the materials used in the coils cannot be selected for their mechanical properties. Essentially, only two materials are used to build power-transformer coils; namely, nearly-pure copper, and paper in a variety of forms.

An analysis of the forces and of methods of applying the materials available shows how successful coil structures can be fabricated.

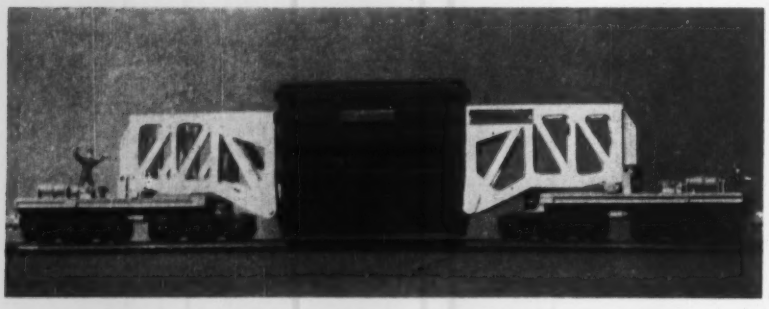
A Special Car for High, Wide, and Heavy Shipments, by R. L. Bean, Mem. ASME, Westinghouse Electric Corporation, Sharon, Pa. 1957 ASME Semi-Annual Meeting paper No. **57—SA-41** (multilithographed; available to April 1, 1958).

TRANSFORMER ratings and voltages have increased so greatly in recent years that transformer shipping weights and dimensions have now reached a critical point. In February, 1947, a shipment was made by the author's company of the first of three 260,000-kva 345-kv transformers, each having a shipping weight of 400,000 lb. The casing of the first unit had to be made with a removable top section for shipment. It was shipped in a heavy-duty railroad car with a height of 49-in. of car floor above the rail.

To alleviate the problem of handling high, wide, and heavy shipments in the future, an entirely new type railroad car has been designed. The design of the car embodies the idea of utilizing the structural strength of the load itself to act as the center portion of the car. It consists, basically, of attaching a set of wheel trucks to either end of the shipment. The primary benefit in such a design comes from being able to lower the load to within a few inches of the rails. A second benefit is that the center of gravity is lowered.

Work Capacities of Energy Storage Systems on Basis of Unit Weight and Unit Volume, by L. V. Kline, Purdue University, Lafayette, Ind.; S. M. Marco, Mem. ASME, and W. L. Starkey, Mem. ASME, Ohio State University, Columbus, Ohio. 1957 ASME Semi-Annual Meeting paper No. **57—SA-7** (in type; to be published in Trans. ASME; available to April 1, 1958).

IN VIEW of current and anticipated interest in conserving weight and space in engineering applications, a study is made of work-per-unit weight and work-per-unit-volume moduli for energy storage systems. Gasoline engines, solid propellants, electrochemical cells, flywheels, compressed gases, compressed liquids, and stressed solids are evaluated. General analytical expressions for the work moduli are derived. For each such general expression, significant optimizing parameters are selected and methods of optimizing the moduli are presented. Information is included pertinent to the problem of selection of energy storage systems for specific applications. Comparisons are made of the practical maximum values of weight and volume moduli for the considered systems. Limitations of the systems, including maximum allowable stress, are discussed.



Model of special car designed for high, wide, and heavy shipments. Loaded with a 500,000-lb transformer, the car will have a gross weight of 750,000 lb

Comparison of Semi-Empirical Solutions for Crack Propagation With Experiments, J. Frisch, Assoc. Mem. ASME, University of California, Berkeley, Calif. 1957 ASME Semi-Annual Meeting paper No. **57—SA-12** (in type; to be published in Trans. ASME; available to April 1, 1958).

THE crack-propagation characteristics of two aluminum alloys and several steels have been investigated in sheet materials under uniaxial tension. Empirical formulas based on ultimate strength and initial crack length were found to be a sufficiently effective method for establishing the relative merit of a material in its resistance to crack propagation. Comparison of experimental data with criteria obtained from the energy-release rate or stress-concentration theory shows that neither method yields reliable material constants.

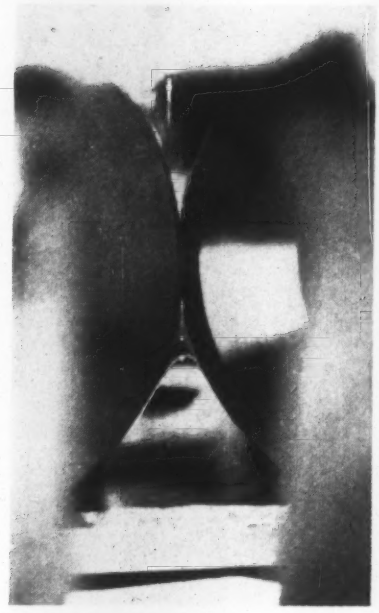
The Effect of Conduit Dynamics on Control-Valve Stability, by F. D. Ezekiel, Assoc. Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1957 ASME Semi-Annual Meeting paper No. **57—SA-50** (multilithographed; available to April 1, 1958).

A METHOD is presented for simulating the dynamic behavior of a frictionless hydraulic conduit with distributed parameters in conjunction with a simple spool-type control valve for analog-computer use. Analytical and experimental results showing the regions of stable and unstable operation of such a system are given, together with suggested stabilizing techniques. The effect of the valve chamber in the over-all analysis is found to be of considerable importance.

Resistance to Rolling and Sliding, by A. C. Dunk, Assoc. Mem. ASME, and A. S. Hall, Jr., Mem. ASME, Purdue University, Lafayette, Ind. 1957 ASME Semi-Annual Meeting paper No. **57—SA-9** (in type; to be published in Trans. ASME; available to April 1, 1958).

IN GENERAL, a single "coefficient of friction" is inadequate to define the frictional resistance between contacting bodies. It is necessary to know both the inclination of the resultant force line and the offset of this line from the theoretical point of contact. This paper presents results of experiments which were made to determine the effects of velocity on the inclination and the offset of the line of action of the resultant force between two disks in peripheral contact.

The results indicate that the sliding velocity is of primary importance in determining the inclination of the line of action of the resultant force. It is the sum of the sweep velocities that is of



Oil arc on recess side of contact region between rotating disks

primary importance in determining the offset of the resultant force line. The nature of the relationship between the angle of inclination and the offset of the line of action of the resultant force, and the proximity of the contact conditions to those existing for pure rolling, were investigated but no conclusive results were obtained.

ASME Transactions

THE June, 1957, issue of the Transactions of the ASME, which is the *Journal of Applied Mechanics* (available at $1 per copy to ASME members; $1.50 to nonmembers), contains the following:

Technical Papers

Inflow Conditions for Supersonic Compressor With Curved Blades, by Philip Levine. (56—A-49)

Two-Dimensional, Steady, Cavity Flow About Slender Bodies, by Hirsh Cohen and Robert Gilbert. (56—A-29)

A New Approach to the Theory of Thin, Slightly Cambered Profiles, by F. S. Weinig. (56—A-33)

Point Source and Point Vortex in the Hodograph Plane, by H. Poritsky and R. A. Powell. (56—A-78)

Effect of Adverse Pressure Gradients on Turbulent Boundary Layers, by J. M. Robertson and J. W. Holl. (56—A-25)

Corrections for the Oscillating-Disk Viscometer, by J. Kestin and H. E. Wang. (56—A-34)

Effect of Stress on Creep at High Temperatures, by H. Laks, C. D. Wiseman, O. D. Sherby, and J. E. Dorn. (56—A-55)

Appraisal of Prot Method for Determination of Fatigue Limit, by W. A. Hijab. (56—A-50)

Reflection of Dilatational Waves at Edge of a Plate, by T. R. Kane

Improvement of Holzer Table Based on Suggestion of Rayleigh's, by S. H. Crandall and W. G. Strang. (56—A-27)

Propagation of Compressional Waves in a Dispersive Elastic Rod—Part I, by Julius Miklowitz

Propagation of Compressional Waves in a Dispersive Elastic Rod—Part II, by Julius Miklowitz and C. R. Nisewanger

Analog Computer for Nonlinear System With Hysteresis, by W. T. Thomson

Response of Mechanical Systems to Random Excitation, by W. T. Thomson and M. V. Barton

Dislocation Over a Bounded Plane Area in an Infinite Solid, by L. Rongved. (56—A-53)

A Theory of Adhesive Scarf Joints, by J. L. Lubkin. (56—A-52)

Some Mixed Boundary-Value Problems of the Semi-Infinite Strip, by G. Horvay and J. S. Born. (56—A-54)

General Instability of a Ring-Stiffened, Circular Cylindrical Shell, by S. R. Bodner. (56—A-30)

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Book Reviews

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Comments on Papers

Including Letters From Readers on Miscellaneous Subjects

Failure of a Welded Drying Drum

Comment by R. D. Barer[1]

HAVING not so long ago written a paper on a boiler tube failure by stress corrosion cracking,[2] I was rather interested in this paper.[3] Unfortunately after examining carefully the evidence presented by these authors, I was forced to conclude that this failure does not represent an example of caustic embrittlement.

My reasons for such a conclusion are briefly outlined as follows:

1 The question of decarburization by hydrogen occupies a good part of the discussion but there is no evidence of decarburization at the fracture (see Figs. 8, 9, and 14). In addition, it is difficult to conceive of much decarburization (Fig. 13) on material which was already of negligible carbon content (Fig. 5).

2 Although brittle behavior is discussed frequently no exact test such as tensile or impact was used to measure this property. As a matter of fact, it is generally conceded that metal in areas away from the cracking is not brittle.[4]

3 The water in the drum is described as being "very caustic" but no analysis of the condensate supplied to the drum is indicated.

4 There is no evidence of branching cracks in Fig. 14. The crack shown in Fig. 15 is from area 1A of Fig. 12 and is not pertinent to the fracture; in fact, it is suggestive of either an original defect in the weld or possibly, corrosion fatigue. Aside, then, from the short grain boundary penetration of Fig. 13 (not pertinent) there is no evidence in this paper of the intergranular cracking which is usually taken as proof of caustic embrittlement. It is suggested that Fig. 12 page 533 in the "Corrosion Handbook" by Dr. Uhlig be compared.

5 The discussion of zone 1B of Fig. 12 bears no relation to the fracture.

6 Regarding the possible concentration of caustic by crevices, it seems inconceivable that such a concentration is ever likely to occur in this drum except in a crack which extends to the atmosphere. In other words, the crack would have had to form before concentration was feasible. Normally cracking is associated with *steam generation* not *steam utilization*. In the present service there is nothing to cause film boiling[5] or evaporation; there is only a cooling or condensing effect which is not likely to give a concentration of any caustic, in fact it is likely to do the opposite.

7 Under "Conclusions" several contradictory statements are made. For example, the decarburization (?) of the plate in Fig. 13 is explained by the following: "May also indicate a caustic environment during service, although it is possible that decarburization occurred during the annealing of the plate."

That the crack may have "progressed too rapidly" to permit decarburization in the fracture zone is not borne out by the six-year service period in the presence of a design weakness or notch. This is followed by two additional statements attempting to explain this lack of decarburization at the fracture: "the concentration of caustic may have been less in this region, or the normalized structure may be more resistant to decarburization."

8 This failure was the result of bad design as indicated by the junction of head to shell in Fig. 1. It is not surprising that fracture took place from this notch in a period of six years with intermittent daily operation.

The fracture surface in Fig. 3, area B, is strongly suggestive of a fatigue failure and this fits the authors' description regarding stress concentration and bending stresses (top of p. 1109).

Not only is the joint design extremely questionable but also the material. It is not usual for a pressure vessel to be constructed of ingot iron, as shown in Fig. 5.

In summary, there is no evidence to support a "caustic embrittlement" diagnosis.

Comment by W. B. Brooks[6]

I HAVE just read "The Failure of a Welded Drying Drum by Caustic Embrittlement" by Sines and McLean in the December, 1956, issue of MECHANICAL ENGINEERING with much amazement.

This is a clear-cut fatigue failure caused by bad design. The tell-tale parallel lines of a progressive fatigue crack may be seen in the B region of Fig. 3, especially in the upper left.

The evidence for caustic embrittlement is exceedingly flimsy. Indeed, the authors' discussion of the "brittle condition of the metal" suggests that they do not even know what caustic embrittlement is. They made a very crude hammer notch bend test and obtained a brittle fracture (not very startling). From this they infer that the metal had in some manner become embrittled. As hundreds of pages in ASME Transactions show, caustic embrittlement is not true embrittlement at all, but rather the development of multiple branching intergranular cracks which cause the metal to exhibit an apparently brittle behavior. It is a form of stress-corrosion-cracking. They show no such cracks.

It is not at all unusual to find oxide in the small root cracks which are all too frequent in welds made with backing rings. The crack forms when the root pass is made. Subsequent passes heat it sufficiently for some oxidation to occur. Oxide is also often found in the older portions of a fatigue crack simply as a result of corrosion.

The authors discuss factors of safety

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[2] "Case History of Failure of Marine Boiler Tubes by Stress Corrosion Cracking," by R. D. Barer, *Corrosion*, vol. 11, no. 4, April, 1955, pp. 148t–154t.

[3] "The Failure of a Welded Drying Drum by Caustic Embrittlement," by G. Sines and E. C. McLean, MECHANICAL ENGINEERING, December, 1956, vol. 78, pp. 1105–1109.

[4] "Recent Research on Caustic Cracking in Boilers," by C. D. Weir, Transaction Institution of Engineers and Shipbuilders in Scotland, vol. 92, 1948–1949, p. 167.

[5] "A New Approach to the Problem of Conditioning Water for Steam Generation," by R. E. Hall, Transactions of the ASME, 1944, pp. 457–488.

"Studies of Heat Transmission Through Boiler Tubing at Pressures From 500 to 3300 Pounds," by W. F. Davidson, et al., Transactions of the ASME, 1943, pp. 553–591.

[6] Lake Jackson, Texas.

based on static stress from the internal pressure and the reduced cross section, and utterly ignore the stress concentration *designed into* the joint by calling for a sharp corner where the cross section of the head is reduced as illustrated in Fig. 1. Stress concentration at sharp reentrant angles has also received hundreds of pages of study in the Transactions.

A drying drum is obviously subject to cyclical stresses from thermal cycling of the drum surface. This is not mentioned, nor are possible vibratory stresses.

The drum had to fail where it did and in the manner it did for purely mechanical reasons. There is no mystery about it. Weep holes will slightly aggravate the tendency to a fatigue failure and you could not pay me enough to stay near a drum of this design with or without weep holes.

The crux of the matter lies in the authors' footnote 4 showing that the design violates the code.

Comment by E. O. Bergman[7]

In footnote 4 to their paper,[3] the authors leave the reader with the impression that the internal sharp corner at which failure began was first explicitly forbidden by the ASME Pressure Vessel Code in its latest editions.

Attention is called to the following wording in Paragraph[8] U-72(*e*) of the 1946 Edition of the Code. "In all cases where plate edges of unequal thicknesses are abutted, the edge of the thicker plate shall be trimmed to a smooth taper extending for a distance at least four times the offset between the abutting surfaces as shown in Fig. U-19, so that the adjoining edges will be approximately the same thickness. The length of the required taper may include the width of the weld."

This wording first appeared in the pink Addenda sheets dated August, 1944. Thus the internal sharp corner used in the vessel was not in accordance with Code requirements in force at the time of the construction.

Comment by I. B. Dick[9]

After prolonged consideration, I do not believe this article should be left unchallenged. Careful study of the evidence presented leads to the conclusion that this failure does not have the aspects of caustic embrittlement, but appears to have resulted from a form of stress corrosion cracking not uncommon in boiler steels. This view is based on (1) the appearance of the cracks shown in Figs. 13 and 15, (2) the environment to which the metal was known to have been exposed, and (3) the design of the welded joint and the adjacent head metal.

The cracks shown in Figs. 13 and 15, with rounded propagating ends, are of the type associated with propagation by oxidation along lines of high stress, and do not at all resemble caustic embrittlement. Caustic embrittlement cracking has the appearance of disrupted grains or grain boundaries with sharp propagating ends and complicated crack pattern.

The operation of this drum hardly seems to present an environment that would cause caustic embrittlement. The drum operated with condensate up to the shaft center line, and with the rate of condensate discharge equal to the inlet steam. The caustic concentration of the water in the drum should then represent the purity of the boiler output steam with no concentration factor. Since this was a welded drum with no seams to leak, and had no heat input, it is difficult to imagine how the internal drum surface could develop areas of high caustic concentration while being turned on its axis.

The design of the drum is admitted by the authors to be faulty. The sharp change in section of the head (a corner of which located the failure) is a source of serious stress concentration and is contrary to the code. This feature alone is sufficient to explain the failure by stress corrosion.

A description of the welding procedure used on this joint would have been helpful in explaining the microstructures of Figs. 6, 7, 8, and 9. This degree of hardening suggests insufficient or no preheat on the head metal. Although this factor may not have influenced the failure, it raises doubts regarding the fabrication of the drum. Information as to the type of steel used in the head would also have been useful.

It is difficult to interpret the work of another laboratory, but inspection of this work leads to the belief that failure resulted from ordinary stress corrosion cracking rather than caustic embrittlement.

Comment by T. M. Swanson[4]

This paper presents an interesting report of a rather complete metallurgical investigation of a drying drum failure. While the authors believe that caustic embrittlement was the major cause of failure, it is suggested that the evidence presented points to mechanical causes of failure aided by corrosion.

The conclusions of the authors were based on:

1 The presence of hydrogen as revealed by the brittle manner in which a sample failed while being removed from the vessel.

2 The columnar decarburized layer on the inside of the shell.

3 Crevice concentration of caustic between backing strips and head weld.

4 Presence of a black oxide corrosion product.

These points will be discussed in order.

1 With regard to the presence of hydrogen, a number of investigators have studied the effect of strain rate and measurement of ambient temperature hydrogen embrittlement in metals. Nearly all have concluded that an impact test is ineffective in measuring this embrittlement, see, for example, Embrittlement of Metals (1). The brittle fracture resulting from a hammer blow presumably at ambient temperature suggests that, instead, the head material has a relatively high brittle fracture transition temperature.

2 It is reported that decarburized columnar grains at the inner surface of the shell wall extend beyond the backup strip. Based on the reported carbon content in the shell plate and the metallographic evidence, this steel is very likely a "rimmed" steel and would be expected to have a lower carbon content in the outer layers of the plate. It would be interesting to know if this decarburized zone was observed on the outer surface of the original shell plate as well. In Fig. 2 it appears that surface metal, at least weld reinforcement, has been removed. It will be noted in Fig. 2 that a layered structure is observable on both sides of the backup strip.

If this decarburization resulted from the service environment, it seems there should be some slight decarburization in the head or in the weld metal despite the different thermal histories.

With regard to the effects of atomic hydrogen on steel, it should be pointed out that hydrogen attack, wherein hydrogen reacts with carbide to form methane, occurs only at relatively high temperature (approximately 1000 F) when the pressure is relatively low.

The methane reaction normally takes place within the metal because the diffusion rate of atomic hydrogen is much

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[8] Assistant chief chemical engineer, Consolidated Edison Company of New York, Inc.

[9] Metallurgist, Shell Development Company, Emeryville, Calif.

greater than that of carbon. This damage is permanent; carbon steel is decarburized and fissured by trapped methane gas.

Currently, ambient temperature hydrogen embrittlement is believed to result from recombination of atomic hydrogen to the molecular form or from the adsorption of hydrogen on a crack surface (4). This type manifests itself as a lack of ductility in a slow mechanical test such as a tensile or bend test, or as blisters when the molecular hydrogen forms and accumulates at discontinuities in the metal.

Evidence relating to the differences between hydrogen attack at high temperature and ambient temperature is pointed out in the discussion which accompanied the authors' second reference.

A more recent paper on caustic embrittlement by Parkins (3) presents a number of points of view. The hydrogen theory and others are critically reviewed. Parkins concludes that no single theory has been adequately proved.

3 The pitting of the inner wall of the shell under the backing strip may have resulted from a concentration cell, especially since the vessel was operated intermittently, but the evidence presented in Fig. 13 and 15 is not suggestive of caustic embrittlement as identified in the Corrosion Handbook (2) or the authors' reference 1. The authors did not show or claim the presence of the characteristic branched intergranular cracking in the failure area.

4 It should be pointed out that the black iron oxide observed by the authors is the common corrosion product observed in steam corrosion; see, for example, The Corrosion Handbook (2).

The authors' analysis of the stresses and the design factors, particularly the sharp re-entrant corner in the head, suggests that high stresses, possibly partly fatigue in nature, are a primary cause of failure with corrosion effects secondary. With regard to corrosion, it appears that it would be useful to eliminate the welding backup strip and thus prevent the accumulation of deposits at the shell surface.

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1 "Embrittlement of Metals," by B. R. Queneau and G. A. Ratz, American Society for Metals, 1956, pp. 18–19.

2 "The Corrosion Handbook," by H. H. Uhlig, John Wiley and Sons, Inc., New York, 1948, p. 533.

3 "Caustic Cracking of Steam Boilers," by R. N. Parkins, *Chemistry and Industry*, Feb. 28, 1953, pp. 180–184.

4 "Stress Corrosion Cracking and Embrittlement," by W. D. Robertson, John Wiley and Sons, Inc., New York, 1956.

Authors' Closure

THE words "caustic embrittlement" were used because, in the past, this term has often included the stress-corrosion cracking in a caustic environment. In a service failure the factors are not neatly isolated, so the appearance of the crack does not always resemble the classic examples, and it is often difficult to use it to identify the primary mechanism. To quote Dr. H. R. Copson:[10] "The borderline between corrosion fatigue, stress-corrosion cracking, and the effects of stress on general corrosion are not sharp."

Some reasons why fatigue was discarded as the primary mechanism, although it may have been a factor, are:

1 It was estimated that the drum had less than 10,000 cycles of pressurization (which seems to be the only significant repeated stress) before failure. Even with a sharp notch, it is difficult to imagine a crack initiating and propagating so rapidly at this stress level.

2 The progressively cracked area had a very constant depth around the nine feet of circumference, which is not common in fatigue.

The effect of a caustic environment over a period of years on notch impact strength is still in dispute. Some short time tests, as Mr. Swanson mentions, have shown little influence of hydrogen under rapid loading of machined notches. It may be that the local plastic deformation at a chiselled notch results in different behavior, because a mild steel as received could have an unusually high transition temperature and not behave so brittlely for specimens of these dimensions. One head sample was only $^3/_4$ in. long, 1 in. wide, with a $^1/_{16}$ in. deep notch made with a dull chisel, but it broke out with a moderate hammer blow. A sample of the shell metal only $1^1/_2$ in. long broke out similarly. This indicates something unusual about the environment because the steels were different.

The area of agreement between the authors and the discussers should be stressed:

1 Dangerous drums have been made in the past (and some may still be in service).

2 This dangerous design is now forbidden, but at one time it was not explicitly forbidden by the Code.

3 The failure was associated with corrosion. In addition to this, the authors feel that the failure was accelerated by an environment considerably more caustic than is usually present in condensate from "zeolite" treated water. We thank those who have written for their interest; it is apparent that this subject can stand more study.

Again we want to acknowledge Mr. Gearon, Chief Boiler Inspector of Chicago, for his efforts to warn the industry.

George Sines.[11]
E. C. McLean.[12]

[10] H. R. Copson, *Corrosion Handbook*, ed. H. U. Uhlig. Wiley, New York, 1948, p. 577.

[11] Department of Engineering, University of California, Los Angeles, Calif.

[12] Industrial engineer, Chicago, Ill.

Radiographic Inspection During Fabrication

Comment by F. T. Philips[13]

THE author of this paper[14] has undoubtedly presented a "first" in this new concept of radiographic inspection of lead linings. The example related at the outset of his paper provides a very good case in point where, in the past, there have been those of us who have experienced a disappointingly poor result with bonded lead construction due to poor quality lead bonding techniques.

A nondestructive testing method such as presented here is of immense value from the customer viewpoint as a quality-control tool. It is now possible to determine with a better degree of assurance that the purchaser is receiving a truly homogeneous lining, both with respect to the lead as well as to the bond. This, of course, in time will become as valuable to lead fabricators as radiographic inspection procedures are at present to steel fabricators.

The author's paper also serves a worthwhile purpose in relating the details of this not-too-well-known art of fabricating homogeneously bonded lead linings. The method described is one of several used by fabricators today. One outstanding feature of this particular method is the ability to float out impurities by pouring and laying down extra thickness for skimming purposes.

Humble has not had occasion to use this radiographic inspection tool as such. However, it probably remains only a matter of time until its use will find its

[13] Baytown Engineering Division, Humble Oil & Refining Company, Baytown Texas.

[14] "A Second Look at Radiographic Inspection of Lead Linings During Fabrication," by William Skiba, MECHANICAL ENGINEERING, December, 1956, vol. 78, pp. 1125–1127.

place alongside other nondestructive test procedures employed at Baytown, Texas, today.

An adaptation of this procedure has been considered as a field inspection method for examining lead linings from the external side of a vessel. This is particularly desirable at times when costly removal of brick linings would otherwise be necessary to permit evaluation of questionable areas of the lining.

The premium of $5\frac{1}{2}$ per cent of the vessel cost for random radiographic inspection is felt to be a reasonable insurance item to assure that the initial cost of the bonded lead construction will be returned through the superior service factor normally associated with bonded lead construction.

Author's Closure

Since publication of the two articles on Lead Radiography, several organizations have formally and informally asked for more detailed information on lead fabrication and the inspection of lead-lined materials. It is quite evident that not only is the inspection of lead-lined equipment difficult, but its fabrication techniques are in the hands of a vanishing race of artisans.

During the presentation of the most recent paper, it was pointed out that this was only the beginning of a technique and it needed development. Correspondence has shown that many concerns are having problems similar to that of my organization. Could it be that some standardization activity or other correlation effort is needed?

W. Skiba.[15]

Engineering Management

Comment by H. W. Roos[16]

This paper[17] covers one of the broadest and deepest areas of possible improvement now apparent on the industrial scene. Several of his remarks move us to offer further comment, in no way taking issue, but endeavoring to suggest amplification or specific approaches.

Reference is made to personal satisfactions enjoyed by an engineer as a lone professional, which may be diluted through group identification. Our experience indicates that the personal satisfactions of achievement can largely be preserved through well thought out planning of work within the group. One basic tenet of a really satisfactory planning system is that it must set goals, which the individual engineer helps to establish, and then follows progress against the plan, so that his performance can be recognized.

The author wisely makes mention of the need for responsibility for solution of supervisory problems. Here again, the necessity for making a plan, and the responsibility of answering for its progress, tend to be strong medicine for developing supervisory strength. Insisting that individuals prepare and follow properly designed plans, according to properly designed methods, is one of the best ways we know of "helping engineers to help themselves."

We think the program described in the paper fills a general void in historic engineering management, but we submit that conferences may be weak unless reference can be made to a satisfactory, specific set of tasks and accomplishments. In short, you preferably do not just point out weaknesses, but rather describe how to improve. Many of the so-called weaknesses in engineering management are vague dissatisfactions which really represent merely the absence of a properly designed control system.

The Atomic-Powered Locomotive

Comment by W. M. Keller[18]

This author of this paper[19] has presented a sketch of what may be expected in the future in using nuclear energy for locomotives. Having read a previous paper by this author on an atomic locomotive, it was possible to consider the contents of this progress report, in which he quotes the previous paper, with some background knowledge of his thinking.

The author presents two major questions on such a locomotive one on economics and the other on safety. Both of these questions will require a lot of research. As the idea of nuclear energy is new, so must be the approach to these problems.

Referring first to economics, it is obvious that the cost levels of fossil fuels are ascending and will continue to do so, even if the dollar value remains constant. The world consumption of fuel is rapidly increasing. The Q's of energy available in the earth must therefore be diminishing. The only available energy to supplement fossil fuel is solar energy and water power. Water power from tide changes may add to the total, but it does not appear at this time that this addition will be significant. Solar power, while in its infancy, may provide a source of power, but it would be optimistic to suppose that for locomotives and power plants this power could provide any appreciable substitute for coal and oil. Consequently, it will be necessary to rely upon nuclear energy as the replacement. The issue will become independent of economics in the future. It will become more a problem of thrift in use of energy rather than a matter of selection. We have been and are profligate in our use of energy.

Homes are badly designed in relation to insulation and other heating considerations. A residence of six rooms requires ten tons of coal to heat. It is not unusual to consume 2000 gallons of fuel oil in a heating season. More thrift is needed in space heating.

Automobiles are over-powered. A modern six-passenger car employs a 300-hp engine, or 50 hp per passenger. A 15-car train capable of comfortably seating 900 passengers can be hauled at today's schedules with a 3000-hp diesel locomotive, or $3\frac{1}{3}$ hp per passenger. While a six-passenger automobile of 20 hp would not suffice for today's traffic, some thrift in power will be required for transportation.

With thrifty use of power, the life span of fossil fuels can be increased, but we are still faced with fuel starvation. Whether this scarcity will occur in 10, 20, or 50 years remains to be determined. It is, however, coming. Consequently, the sooner we are prepared to adopt nuclear energy, the less troublesome the change-over will be.

The liability from nuclear damage to persons, livestock, property, and the like, is undoubtedly a problem. The entire concept of liability certainly requires study and revision, even under today's conditions without nuclear energy. The tendency for juries to award fantastic sums for real and alleged injuries certainly is one of the dark spots in American jurisprudence. As an automobile driver, one carries up to $300,000 liability provision in his insurance. This is, of course, for personal injury as no car would conceivably cause such property

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[16] Vice-President, Wallace Clark & Company, Inc., Management Consultants, New York, N. Y. Mem. ASME.

[17] "Human Factors in Engineering Management," by H. M. Miller, Jr., Mechanical Engineering, vol. 79, February, 1957, pp. 152–153, condensed from ASME Paper No. 56—F-12.

[18] Director of Mechanical Research, Association of American Railroads, Chicago, Ill. Mem. ASME.

[19] "An Atomic-Powered Locomotive?" by Bruce C. Gunnel, Mechanical Engineering, vol. 79, March, 1957, pp. 266–267.

damage. Such protection is out of line with the hazard present in automobile driving.

In the case of atomic injury the burden of proof would be with the user of such power. Here radiation injury claims could take on strange proportions. Sterility, cancer, sight loss, or even bald heads might become the basis of litigation, regardless of any actual relationship to radiation. Defense against such suits would be extremely difficult.

Consequently, assurance that catastrophic damage claims could be avoided would be necessary if atomic energy is used. Certain general damage occurrences are referred to as "acts of God." Floods, fires, and events outside the control of man fall into this category. However, there are occurrences that should engage the minds of those who approach this liability problem. One carries fire insurance only on his own property. In a conflagration, the owner of the property in which the fire started is not liable for all the damage that ultimately occurs. Nor have I ever heard of a suit against the fire department for failing to prevent fire from spreading. Thus there appears to be some basis for new laws to control atomic damage suits. Some kind of insurance where limited liability is invoked would be helpful, particularly with a government reinsurance arrangement. The author has suggested the latter possibility in his paper. It seems that such an insurance provision by the government will be necessary to expedite the use of atomic energy. Regardless of the magnitude of this problem, however, it must be resolved so that this legal aspect of nuclear energy will not present a barrier to the further development of atomic energy for peaceful purposes. This entire legal problem of liability appears to be one for the legal profession rather than for the engineer.

The author has made a contribution to the literature on this subject and no doubt this paper will generate additional interest and work on this important subject.

Comment by D. H. Brown[20]

THE feasibility of the application of atomic power to locomotives merits the most objective appraisal. The author is commended for bringing so much order to this subject and reducing to numbers aspects that are generally matters of conjecture. Two aspects of fuel economy need further examination since the comparison presented was based entirely on full load operation.

Locomotives in all operations spend considerable time at stand-by. If the load cycle were half time at full power, and half time at stand-by, then the atomic locomotive would consume three times the Btu required by the diesel unit. This figure is half again as large as the ratio presented in the paper. More accurate estimates for domestic service may be found in the paper "Direct Coal Burning Gas Turbine Operations," presented by P. R. Broadley and W. M. Meyer of Bituminous Coal Research, Inc., at McGill University Conference on the Coal Burning Gas Turbine, November, 1956. These load factors vary from 56 per cent to 83 per cent.

The use of atomic power presents a second serious reduction in fuel economy. When a diesel is shutdown its fuel rate is reduced to zero. This is not the case with a nuclear reactor. It is well known that radioactive decay continues to release thermal energy from the reactor after shutdown. This decay curve may have a value of 0.8 per cent of full load rate at the end of one day of shutdown and 0.4 per cent at the end of one month of shutdown. The integral of Btu dissipated during shut down may greatly reduce the utilization of the available thermal energy by intermittent power cycles typical of locomotive practice. This loss would be trivial for central power stations.

In conclusion, locomotive power plants cannot be compared on the same basis as central power stations. The influence of part load and no load fuel or energy rate is of equal importance to full-load efficiency. The tendency of a nuclear reactor to dwindle down rather than shut off when made subcritical, must be assessed when considering intermittent reactor operation.

Another aspect of intermittent reactor operation requires proof of feasibility. That is the ability to cool the reactor immediately after shutdown. For central station reactors this condition is termed "emergency cooling." Unless the locomotive carries an auxiliary diesel, or stores sufficient energy to provide coolant circulation, then "emergency cooling" will be one of its most regular operations. This is achieved by natural convection circulation in central station reactors. However, the low head available in a locomotive cab may be expected to limit the use of this process unless the reactor coolant is discharged into the air directly. Then the question of danger to personnel becomes paramount.

These considerations are presented in the belief that achievement of feasibility is best assured by the stimulation of an objective appraisal of all limiting phenomena and conditions.

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And Notes on Books Received in Engineering Societies Library

Gas Dynamics

GAS DYNAMICS. Vol. 1, applied mathematics and mechanics. By Klaus Oswatitsch. English version by G. Kuerti. Academic Press, Inc., New York, N. Y., 1956. Cloth, 5½ × 9 in., tables, figs., references, bibliography, author and subject indexes, charts in envelope attached to back cover, xv and 610 pp., $12.

Reviewed by H. E. Bailey[1]

THIS book contains a thorough and complete treatment of compressible fluid flow. All analyses are based on the assumption that the fluid is a continuum.

A brief introductory chapter on thermodynamics is followed by a detailed discussion of both steady and unsteady one-dimensional flows. The conservation theorems of mass, momentum, and energy are then derived first in integral form and then in differential form. The integral theorems are then applied to a

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few special cases; e.g., thrust on a nozzle, deflection of a jet, and the like. The conservation theorems in differential form are used to discuss certain particular exact solutions of steady, inviscid, compressible flow; e.g., source flow, vortex flow, Prandtl-Meyer flow, and the like.

Relaxation methods in subsonic flow, characteristics methods in supersonic flow, as well as linearization of the flow equations, are covered in detail for steady, inviscid plane and axisymmetric flows. A summary of the theoretical methods available for the solution of steady, inviscid transonic flows is also given. The flow past flat lifting wings is discussed for both supersonic and subsonic compressible flows.

A brief chapter on the effect of viscosity on compressible flow is included. The book ends with a few words on experimental techniques.

The treatment throughout the book, with the exception of the last two chapters, is thorough. Methods of solution, rather than solutions of specific problems, are discussed. The author emphasizes the physical interpretation of flow phenomena and the interrelationships between various types of flows, e.g., steady plane flow and unsteady one-dimensional flow. Extensive bibliographies are given at the end of each chapter.

Books Received in Library

ASTM Standards in Building Codes. Supplement to 1955 Edition. Published 1956 by The American Society for Testing Materials, Philadelphia, Pa. 214 p., 6 × 9 in., paper. $2.75. Together with the 1955 compilation, this supplement provides a convenient source for ASTM standards on the full range of construction materials, including structural and reinforcing steel; copper, cast iron, and steel pipe; building units; bituminous roofing; cement; gypsum; and ready-mixed concrete. The supplement includes seven new specifications, two new methods of test, descriptions of the revisions of 63 standards, and 21 extensively revised standards in full.

Momentum Transfer in Fluids. By W. H. Corcoran, J. B. Opfell, and B. H. Sage. 1956, Academic Press Inc., Publishers, New York, N. Y. 394 p., 6 × 9¼ in., bound. $9. This book aims to give sufficient background in laminar and turbulent shear flow, boundary-layer analysis, and the statistical treatment of turbulence to give the reader an understanding of the nature of local fluid motions frequently encountered in industry. Considerable stress has been placed on the behavior of laminar-boundary layers and the transition from these boundary flows to the main boundary of a turbulently flowing stream. A full chapter has been devoted to the basic equations of the motion of fluids, and laminar and turbulent boundary flow for a compressible fluid have been discussed briefly. The level of treatment assumes a knowledge of calculus and the elementary principles of differential equations.

Oxydation von Metallen und Metallegierungen. By K. Hauffe. 1956, Springer-Verlag, Berlin, Germany. 389 p., 6¼ × 9⅜ in., bound. DM 48.00. This treatise on the oxidation of metals and alloys deals with the mechanism of oxidation, the classification of scale, and the outlook on oxidation-resistant materials. It covers general chemical aspects, pitting and diffusion phenomena, the theory of oxidation attack, scale formations, the action of sulphur and oxygen on specific metals and alloys, and methods of measurement of oxidized layers.

Oxygen in Iron and Steel Making. By J. A. Charles, W. J. B. Chater, and J. L. Harrison. 1956, Interscience Publishers Inc., New York, N. Y. 309 p., 5½ × 8¾ in., bound. 56.50. A review of previously published information, together with the results of some unreported trials made by British iron and steel-making companies. About half of the contents is devoted to the treatment of molten metal—the desiliconization of iron; oxygen in the Bessemer process; oxygen injection in the open-hearth process; the use of oxygen in the electric-arc furnace for the production of stainless steels, and the effect of oxygen treatment on metallurgical properties. The remainder of the book is concerned with flame enrichment and with blast enrichment as applied to the blast furnace, the cupola, and the gas producer.

The Physics of Nuclear Reactors. (British Journal of Applied Physics, Supplement No. 5.) 1956, Institute of Physics, London, England. 111 p., 8 × 10¾ in., boards. 25s. This conference was held as a means of informing physicists and engineers of recent advances in nuclear reactors and of problems needing solution. The 13 papers, with discussion, published in this supplement deal with the physics of experimental and advanced reactors, recent developments in nuclear theory, reactor shielding, control, and instrumentation; the role of chemistry and metallurgy in a nuclear energy project, and the effects of irradiation on the physical properties of solids. One paper is devoted to the zero-energy fast-breeder reactor, ZEPHYR, and two to descriptions of Canadian and British research reactors.

Plasticite. Déformations Élastico-Plastiques. By A. A. Ilioushine. Translated from Russian. 1956, Editions Eyrolles, Paris, France. 376 p., 6¼ × 9¾ in., bound. Fr. Frs. 5300. The author provides a new synthesis of the various theories in the field of plasticity, particularly with regard to plastic deformation beyond the elastic range, including a strict mathematical treatment of problems and experimental verification of the laws. For the engineer, the treatment of elastico-plastic deformations and the limiting states of mechanical strength is important, particularly in dealing with plates and shells, cold forming of metals, punch penetration, metal creep, etc.

Recherches sur la Combustion d'un Mélange d'Hydrocarbures. By J. Rappenau. (Publications Scientifiques et Techniques, No. 318.) 1956, Ministère de l'Air, Paris, France. 90 p., 7⅛ × 10⅝ in., paper. Fr. Frs. 1100. A detailed study of the combustion of kerosene in air and of the characteristics of the kerosene-air flame. Of particular interest is the chapter on combustion in a turboreactor chamber.

Library Services

Engineering Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

Relaxation Properties of Steels and Super-Strength Alloys at Elevated Temperatures. Compiled by an ASTM-ASME Joint Committee. (Special Technical Publication No. 187.) 1956, American Society for Testing Materials, Philadelphia, Pa. 97 p., 8⅜ × 11 in., paper. $4. Tables and graphs give relaxation strengths for low-alloyed Mo, Cr, and V-bearing steels; 12 per cent Cr-type steels; a number of superstrength alloys; and cast iron. Residual stresses for relaxation to 100, 500, 1000, and 10,000 hours are used as the main measure of relaxation strength, and the temperatures covered range from 750 to 1100 F with data at 1200-1500 F for superstrength alloys. The tables also give chemical composition, heat treatment, mechanical properties at room temperatures, and limited creep data.

Rheology—Theory and Applications. Vol. 1. Edited by Frederick R. Eirich. 1956, Academic Press Inc., Publishers, New York, N. Y. 761 p., 6 × 9¼ in., bound. $20. The present volume is the first of three volumes planned to present an integrated survey of present knowledge of rheology. It contains introductory chapters from the physico-chemical and the physics and engineering viewpoints, five chapters on various aspects of the deformation of solids, and four chapters on disperse systems. Other chapters deal with flow under high pressure, the mechanism of liquid flow, large elastic deformations, viscoelasticity, melt flow, and the acoustic responses of liquids. Each chapter has been contributed by a specialist in the topic covered.

Stahlbau. Vol. 1. Sponsored by Deutscher Stahlbau-Verband. 1956, Stahlbau-Verlags, Cologne, Germany. 317 p., 6½ × 9½ in., bound. DM 28.50. A handbook on structural analysis and design that covers both theory and practice. Beginning with introductory chapters on the mathematics and materials involved, the author then devotes the major part of the work to a detailed treatment of the statics of structures including space frames and indeterminate structures. The book closes with chapters on stability investigations and vibration theory.

Die Theorie der Drillfestigkeit von Stahlbauteilen. By F. Wansleben. (Forschungshefte auf dem Gebiete des Stahlbaues, No. 11.) 1956, Stahlbau-Verlag, Cologne, Germany. 52 p., 7½ × 11¾ in., paper. DM 13.50. A presentation of the theory of torsional resistance of structural steel members, with examples of application to both straight and curved beams of various cross section. Examples of stress analysis are given, and some standard sections are considered as well as theoretical shapes.

Roundup

Of Current Engineering Events, News, and Comment

E. S. Newman, *News Editor*

Co-operative Education—Where It Stands, Its Place in the Future

Edison Foundation Conference hears educational and industrial opinions

"How are we going to give all our young people who desire a college education the chance to obtain it?" "How can we meet the shortage of teachers and facilities?" "Does co-operative education—whereby the student alternates one to three months in the classroom with a similar period in industry—hold the key?"

These questions were asked by Charles F. Kettering, Fellow ASME, in his opening statement to educators and industrialists assembled for a conference on "Co-operative Education and the Impending Educational Crisis." The Thomas Alva Edison Foundation, of which Mr. Kettering is president, sponsored the meeting in Dayton, Ohio, on May 23 and 24.

"We are not trying to sell co operative education," Mr. Kettering continued. "We are here to analyze its positive and negative factors. In the next dozen years, college enrollments will double, and traditional educational programs are not big enough nor good enough to meet this crisis. In California, 51 per cent of last year's high-school graduates are now attending college—a condition which experts thought could not occur before 1970."

"The mixture of job experience and education deserves wider understanding by the parents of those who will be seeking to enter college in the years to come. Many will encounter serious difficulty in finding institutions with room to admit their children."

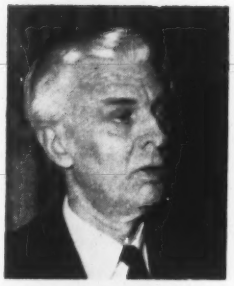
"The purpose of this conference on co-operative education is to give those interested in the problems of higher education a chance to look at the existing working models of co-operative education. The colleges and universities now using a co-operative education—the University of Cincinnati, Antioch College, Northwestern Technological Institute, the University of Detroit, General Motors Institute, Northeastern University, Drexel Institute of Technology, Rochester Institute of Technology, and others—offer action demonstration of what may be part of the answer in meeting the tidal wave of students wanting advanced education."

The Edison Foundation meeting was attended by representatives of over 80 colleges and universities of the Eastern and Middle Western United States, and representatives of about 95 firms which employ co-operative students. Among them were delegations from the University of Michigan and Michigan State University, which had announced plans earlier this year to launch their first formal co-operative educational programs. Other universities which have not yet made public their plans to open co-operative programs were also represented, as well as some firms laying the groundwork for employment of co-operative students. There were also a number of officials from state departments of education and other interested individuals. The total attendance during the two days was about 270.

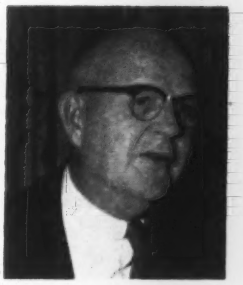
What Is Co-operative Education?

"The basic philosophy of co-operative education," Henry H. Armsby told the group, "is that it is an educational program. Everything else must yield to educational values. It is essential that not only colleges, but industry, understand this basic thesis. The patterns of its application are many and varied, but co operative education is a philosophy, not a mechanism." Dr. Armsby, who is Chief for Engineering of the U. S. Office of Education, traced the growth of co-operative education from its founding in 1906 at the University of Cincinnati, in engineering, by the late Herman Schneider, professor and later dean of engineering. "Schneider found while he was at Lehigh University that students who performed well in school had had practical experience either before entering college

H. L. Bevis, ***left,*** **chairman of the National Committee for the Development of Scientists and Engineers, and C. H. Faust,** ***center,*** **president of the Fund for the Advancement of Education and vice-president, Ford Foundation, listen as C. F. Kettering, Fellow ASME, president of the Thomas Alva Edison Foundation, makes a point. They were attending the Edison Foundation conference on "Co-operative Education and the Impending Educational Crisis" held in Dayton, Ohio, May 23–24.**



C. H. Linder



C. R. Osborn

S. C. Hollister

Some of the outstanding leaders from education and industry served as featured speakers at the conference. C. H. Linder, Mem. ASME, addressed the opening luncheon on "Breaking Down the Barriers Between Industry and Education." C. R. Osborn, vice-president, General Motors Corporation, at the closing luncheon, discussed "The Triple Profits System." Solomon C. Hollister, Hon. Mem. ASME, dean, College of Engineering, Cornell University, gave the first major address of the conference on "Mutual Obligations of Industry and the Engineering Colleges."

C. J. Freund, Fellow ASME, leads one of the six simultaneous panels discussing the potentialities of co-operative education. *Left to right* are the panelists: E. M. Strong, director, engineering industrial co-operative program, Cornell University; Dr. Freund; S. D. Marble, panel chairman, president, Wilmington College; T. H. Brinkmann, department of industrial relations, Northwestern University; and F. M. Wright, director of training, International Harvester, Inc.

At another of the six panels discussing the potentialities of co-operative education, the leaders, *left to right,* are: D. C. Hunt, director, co-ordination and placement, University of Detroit; Thomas Johnson, director, personnel and training, Danly Machine specialties; H. L. Bevis, chairman of the panel; H. K. Justice, dean-elect, College of Engineering, University of Cincinnati; and H. L. Solberg, Fellow ASME, head, School of Mechanical Engineering, Purdue University

or while they were attending." Schneider's initial plan included only 27 students and 12 firms. The latest compilation of co-operative enrollment shows 13,161 students in engineering curriculums and 5945 in nonengineering curriculums (1953–1954).

In June, 1956, 1838 engineering students were graduated from co-operative programs, which is somewhat more than five per cent of the engineering graduates in 1956. The U. S. Office of Education now lists 43 degree programs and eight nondegree programs (1954–1955). The 43 degree-granting institutions offered 16 different engineering curriculums (including 37 programs in mechanical engineering), and 18 different nonengineering curriculums (for example, business administration, architecture, science, education, home economics, arts, and sciences). The number of companies now training students through this plan runs into the hundreds.

Clarence H. Faust, president of the Fund for the Advancement of Education and vice-president of the Ford Foundation, discussed the question of "The Deployment of Our Resources for Higher Education."

He warned that "if we are going to give education for all, we shall have to provide not one small and special class of professional teachers, but we shall have to draw upon all the resources of the community." On the basis of enrollment trends, he said, it would be necessary for half of all college graduates over the next ten years to enter teaching to maintain our present balance between teachers and students—but at the present time only one-fifth of the college graduates have been entering teaching. "The question is not whether people who want an education will receive it, for certainly their desires will be served. The question is what kind of college education they will get." The problem, he said, has three interrelated aspects: the recruitment of a large number of able people for teaching; provisions to prepare them well for teaching; and more effective utilization of teaching resources."

"We have a touching faith in the course as almost the only instrument of education and indeed as the essence of education," Dr. Faust continued. "The consequence is a wasteful proliferation of courses in colleges and graduate schools—wasteful of faculty time, and inefficient and ineffective in the education of students. It gives the students the impression that they cannot be expected to learn about anything without taking a course in it." Dr. Faust suggested there was much to be gained in the use of human and mechanical aids to the

teaching profession, such as support all other professions.

Clarence H. Linder, Mem. ASME, vice-president of Engineering Services for the General Electric Company, commented on the need for breaking down the barriers between industry and education. He and his associates are spending a substantial amount of time with the colleges and universities to gain a better mutual understanding of their common problem. On industry's side it has been pointed out that there is a growing need for men trained in greater depth to perceive as well as solve the barrier problems that face industry today. In turn, the engineering colleges have asked about such questions as "the advisability of offering a BS degree in nucleonics engineering." Mr. Linder stated in his answer that he did not believe this advisable in the best interests of the student or of industry. He suggested that it is not possible to establish competence in a broad area of this kind in a four-year degree program, as this particular problem needs to have brought to bear upon its solution many disciplines both in science and technology, with some in great depth.

Triple-Profits System

Co-operative education was viewed by Cyrus R. Osborn, vice-president of General Motors Corporation, as "The Triple Profits System," with advantages for the university, the student, and industry. "In the course of his work periods, the student finds out quickly whether or not engineering is for him. He does not need to wait more than four years. He gets a better idea of the kind of work he likes and is best equipped to do. By the time he graduates he has built up a record of achievement."

Mr. Osborn, who is himself a graduate of the University of Cincinnati's co-operative plan in engineering, pointed out that alternating study and employment in industry bridges the "gap between theory as covered in textbooks and modern day design practice."

S. C. Hollister, Hon. Mem. ASME, dean of the College of Engineering of Cornell University, discussed "Mutual Obligations of Industry and the Engineering Colleges." He stressed the need to make the best use possible of the engineers we now have and are graduating, as the country is probably at the saturation point on the percentage of engineering graduates to be expected from each crop of 18-year-olds. Competition from science, medicine, law, and some skilled trades, is partly responsible, since the fields also "want the type of boy who would be capable of making a good engineer."

Howard K. Justice, dean-elect of the University of Cincinnati College of Engineering, said that "the talent is already swarming at the doors of our engineering colleges, only to be turned away. What are we going to do about this? Without financial help, most educational institutions will be unable to provide the staff and facilities necessary to cope with future enrollment." Dr. Justice paid tribute to the gifts, regularly bestowed on American colleges and universities, many of which "would long since have passed out of existence" without it. So vital is industry support of higher education that he proposed "there seems to be a need for some sort of regulatory device or central agency for evaluating the financial needs of our colleges and universities, and perhaps even for controlling or dispensing industrial contributions to them on some sort of equitable basis." He said that the gross national product would be increased by such a plan.

The president of General Motors Institute, Guy R. Cowing, Mem. ASME, spoke of the successful operation of the co-operative education plan at the central training and educational agency of General Motors Corporation. "Complete knowledge of all engineering subjects does not constitute ability to practice engineering. The engineering concepts, principles, and laws must be properly integrated with the available or procurable plant equipment, test data, time considerations, and so on, to produce a desired result economically, and yet with safety and equity to all concerned. This requires a combination of resourcefulness, initiative, experience, stick-to-it-iveness, and sound judgment which are the characteristics of a successful engineer. The co-operative student learns how his academic training is actually applied in industry. The plant is a huge laboratory to be used for the development of his experience and knowledge, and the classroom work can be concentrated upon the 'why' of engineering."

Power D. Custer, vice-president of industrial relations for W. K. Kellogg Company spoke of the advantages to a small company in co-operating in the training of students. Because of the on-the-job indoctrination during school years rather than after graduation, "a co-op student can be given basic training in rough, simple, and routine assignments which could not practically be given to a graduate student. This training also reduces problems of engineers coming into an organization after graduation with delusions of grandeur."

R. A. Whitehorne, manager of engineering recruiting at International Business Machines, said that "the co-operative program helps the student build up a 'panic barrier' which is a valuable trait to have in engineering work. The further a man goes in research or engineering today, the greater the chances of coming across dead-end situations where completely new frontiers must be established in technology."

At the close of the meeting, Mr. Kettering suggested that the group consider meeting again in two years to assess the progress made in the intervening period, a period during which college enrollments may well pass the three and one-half million mark.

The conference was not all business—"Boss" Ket, *left*, leaves them laughing. Enjoying the fun are: J. R. Dunning, Mem. ASME, dean, School of Engineering, Columbia University; G. B. Carson, dean, College of Engineering, Ohio State University; and W. C. Langsam, president, University of Cincinnati.

TOWARD UNITY?

AIEE President's Report on suggested division of activities of AIEE, ECPD, EJC, and NSPE

In a message to ASME members appearing on this month's editorial page, President Ryan refers to a report to AIEE members by M. S. Coover, president AIEE, published in *Electrical Engineering*, June, 1957. This report is reprinted here at President Ryan's suggestion.

At the Council Meeting in San Francisco, Mr. Ryan presented the AIEE program, which was well received and is to be discussed at the 1957 Annual Meeting.

Mr. Coover's report follows:

"Based on a survey of membership in 1947, our Board of Directors has followed an "Institute Policy" expressed in the following "Statement" adopted on June 15, 1950 (Year Book 1954, Resolution, p. 609):

1 To work continually for the unification of the profession.

2 To recognize the fact that the Institute finds its chief reason for existence in the technical field.

3 To handle questions on nontechnical affairs as necessary and as they arise, on an emergency basis until through unification they can be handled on a general professional basis.

"In 1941 AIEE and the other Founder Societies, joined in 1942 by the American Institute of Chemical Engineers (AIChE), formed the Engineers Joint Conference, which in 1945 became the Engineers Joint Council (EJC). Although recognized initially as a Federation of Societies, it was hoped that EJC eventually would develop into a 'Unity' organization of the type for which our membership had expressed a preference; namely, a society based on individual membership, with power to act and adequately financed.

"In reappraising this situation, the AIEE Board has reached the conclusion that there is little likelihood in the immediate future of welding the activities of the various technical and professional societies into one 'American Engineering Association' to parallel the American Medical Association (AMA) and American Bar Association (ABA). Accordingly, for the present, the AIEE Board believes that the several established organizations should operate in accordance with the division of activities outlined below, and proposes to furnish moral and financial support on this basis.

"1 Electrical Engineering. AIEE to provide the medium for advancement in technology in all branches of electrical engineering and devote its efforts to this end. It is recognized that excellent services are being rendered in specialized areas of electrical technology by other Societies. AIEE will co-operate with these societies. If mutually satisfactory arrangements can be effected, AIEE is agreeable to a merger into one organization for economy of operation and coordination of activities.

"2 Engineering Other Than Electrical. EJC to provide the medium for co-ordination and co-operation on technological matters transcending the electrical field, and present to the public the position of the engineering profession on technological matters.

"For these purposes, a Federation of Societies is adequate. Accordingly the AIEE Board proposes that in the future it will support and participate only in the technical activities of EJC.

"3 Engineering Education. Engineers' Council for Professional Development (ECPD) provides the medium for guidance in engineering education (*a*) during high-school preparation, (*b*) during the undergraduate and postgraduate collegiate periods, and (*c*) during the 'engineer-in-training' period for a professional career. It could be delegated to represent the engineering profession in all educational matters.

"4 Professional Development and Economic Status. National Society of Professional Engineers (NSPE) to provide the medium for the general promotion of the professional aspects of engineering in the eyes of the public, and consequent enhancement of the economic status of engineers. The term 'professional,' as differentiated from technical and educational, is construed to include such activities as registration, employment practices, salaries and fees, legislation, and ethics.

"5 Co-ordination of Activities. To implement this policy, the AIEE Board proposes that the several activities presently individually sponsored by these organizations be assigned according to the above delineation of scopes, namely, Technological (EJC), Educational (ECPD), and Professional (NSPE). Separation and realignment of activities into these three categories could eliminate present confusion and wasteful duplication of effort.

"If each of the organizations establishes itself in the fields indicated, it is believed that many of the advantages desired of a 'Unity' organization may be realized. Eventually, it may be possible to incorporate them into one over-all engineering association.

"6 Expansion of NSPE. AIEE has for many years recommended to its members that they should take steps to register as professional engineers. NSPE should put itself in a position to represent the profession more completely by expanding its individual membership organization to include as well as registered engineers those qualified members of the profession whose work does not by law require registration. Under such conditions, the AIEE Board proposes to recommend that all its members affiliate with NSPE.

"Informational: In response to action by our Board of Directors on October 5, 1956, your President has discussed informally, personally, and/or in writing, the above with the incumbent and incoming presidents of many of the national engineering societies. They were requested to indicate, from a purely personal viewpoint only, whether they believe there is merit in further explorations. Their response has been encouraging.

"On reporting this to our Board of Directors at its January 25, 1957, meeting, your President was instructed to proceed with the project. This letter is intended to be in the nature of a progress report to you.

"I have yet to hear any engineer, regardless of his society affiliation, express opposition to unification of the engineering profession. The usual comment is, 'the sooner the better,' or 'why doesn't someone do something about it?' If unification is ever to be accomplished, we must keep working at it continually. If you really believe in the project as you have indicated through the survey of our membership, then I invite every contribution that you are able to make."

Third U. S. National Congress of Applied Mechanics Announced

Brown University, Providence, R. I., June 11–14, 1958, to be headquarters

The U. S. National Congress of Applied Mechanics is held every fourth year under the auspices of the U. S. National Committee on Theoretical and Applied Mechanics, a joint committee of the American Institute of Chemical Engineers, the American Mathematical Society, the American Physical Society, the American Society of Civil Engineers, The American Society of Mechanical Engineers, the Institute of the Aeronautical Sciences, and the Society of Experimental Stress Analysis. These congresses are planned to supplement the International Congress of Applied Mechanics but not to compete with it. Accordingly, no effort is made to attract papers from outside the United States and Canada, although there is no rule against their presentation.

All research workers in the field are cordially invited to submit papers constituting original experimental or theoretical contributions to Applied Mechanics, including mechanics of rigid bodies and deformable solids, mechanics of fluids and gases, thermodynamics and heat transfer. It is expected that papers accepted by the Editorial Committee with the advice of recognized authorities and presented at the congress, will be published in full in the proceedings of the congress.

To be considered for presentation at the congress, complete papers and manuscripts must be submitted to the chairman of the Editorial Committee before Jan. 1, 1958; to be scheduled for presentation the final manuscript of a paper must have been accepted before May 1, 1958. To avoid delays caused by overburdening reviewers and editorial staff, authors are urged to submit manuscripts well ahead of the deadline of Jan. 1, 1958.

The papers will be grouped by subject and 30 minutes will be allotted for presentation and discussion of each paper. Arrangements will also be made for general lectures by outstanding authorities on subjects of general interest to members of the congress. Facilities will be provided for informal discussions and social meetings.

The personnel of the Organizing Committee includes the following: William Prager, Mem. ASME, chairman; D. C. Drucker, Mem. ASME, secretary; E. H. Lee, Mem. ASME, treasurer; R. M. Haythornthwaite, chairman, Editorial Committee; and E. T. Onat and E. T. Shield, Committee on Arrangements.

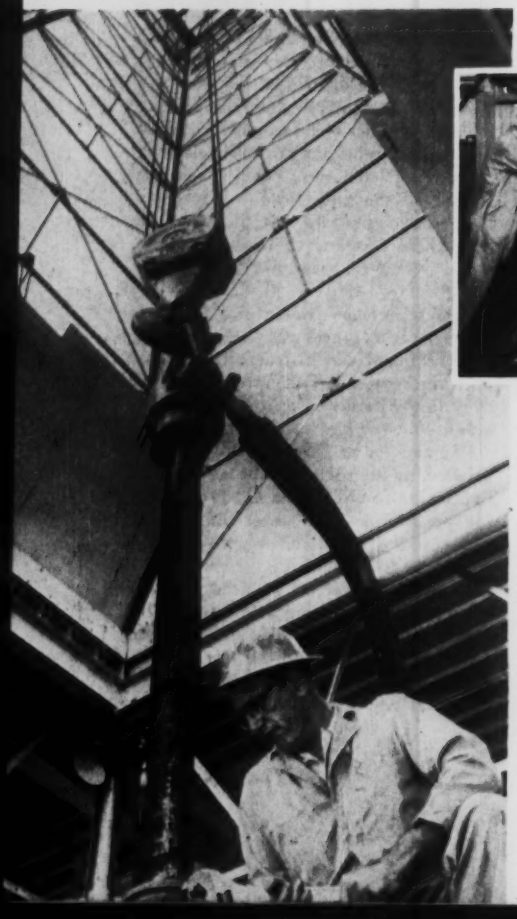
The Editorial Committee, in addition to Mr. Haythornthwaite, the chairman, lists the following: L. H. Donnell, Mem. ASME; M. M. Frocht, Mem. ASME; J. M. Goodier, Mem. ASME; Arthur Kantrowitz; Hans W. Liepman; P. M. Naghdi, Assoc-Mem. ASME; Walter Ramberg, Mem. ASME; Hunter Rouse, Mem. ASME; W. R. Sears; J. J. Stoker; and E. Wenk.

Inquiries regarding the congress should be addressed to the secretary of the congress at Brown University, Box D, Providence 2, R. I.

Industrial Films

Management

"Electric Computers Improve Management Control" is a film which can be



◀ ***Door in the roof.*** The roof opens to reveal 80-ft drilling rig which will allow full-scale, all-season drilling experiments. Technician tightens nut at drill-platform level; the drill bit is positioned 13 ft below at building-floor level. *Inset*, water for carrying off drilling debris begins to fountain up as technician guides withdrawal of the bit from a block of granite after an experiment run. Field operations can be duplicated here.

▼ ***Twenty-two years of research growth.*** Aerial photo of the 44-building Gulf Oil Research Center, Harmarville, Pa., where three new laboratories were formally opened on May 29. The laboratories are designed to improve methods of oil production and handling of well fluids; betterment of fuels and lubricants for automotive, aviation, and marine engines; and application of nuclear energy to all phases of petroleum science. Photo, *inset*, dramatizes Center's growth since operations began here in 1935.

of value to top management in understanding the potentials of electronic data processing techniques in their businesses.

The film is available for rental and for sale. Inquiries may be directed to the Educational Film Sales Department, University Extension, University of California, Los Angeles 24, Calif. Refer to: Cat. No. EF 5610; 15 min. color; price: $150; rental: $10.

Paint Masking

"Pete, the Paint Boss, and the Efficiency Expert," a 10-min, sound-strip film, describes industrial paint-masking methods. The film, made for in-plant showing, is part of an over-all demonstration of masking tape properties, masking techniques, and mechanical aids. It shows how industrial paint-masking methods can increase efficiency and reduce production costs.

Arrangements to see the film may be made through representatives of the Minnesota Mining and Manufacturing Company, 900 Fauquier Avenue, St. Paul, Minn.

Grinding Wheels

"How to Select the Right Grinding Wheel," a film which explains the meanings of typical grinding wheel markings, but shows the different variations of each unit symbol, has been completed by the Norton Company, Worcester 6, Mass. The 30-min, 16-mm, sound and color film develops recommended grinding-wheel specifications for two different and specific grinding jobs.

Users of industrial grinding wheels may obtain the film by writing to the Norton Company or any of its district offices.

Aluminum Finishing

"Aluminum Finishing," a full-color, 16-mm, 15-min, sound film, is available from Turco Products, Inc., 6135 South Central Avenue, Los Angeles 1, Calif. The film, intended primarily for training purposes, demonstrates every aspect of aluminum finishing from precleaning prior to conversion coating to painting and final assembly.

In a detailed laboratory sequence, the film also describes the theory behind all of the steps required to properly finish aluminum.

Turco field service representatives are available in all sections of the United States, and will show the film to industrial concerns, technical groups, and other interested organizations.

IMechE Meetings

July 12, 1957
Thermodynamic and Transport Properties of Fluids, 27 papers, IMechE, London

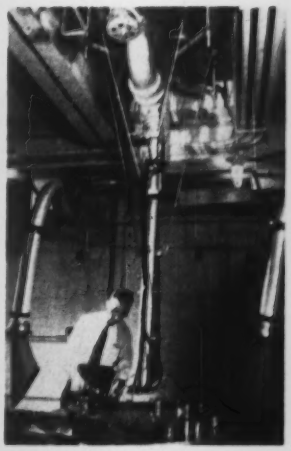
Oct. 1–3, 1957
Lubrication and Wear, 150 papers IMechE, London

February, 1958
Technology of Engineering Manufacture, 60 papers, IMechE, London

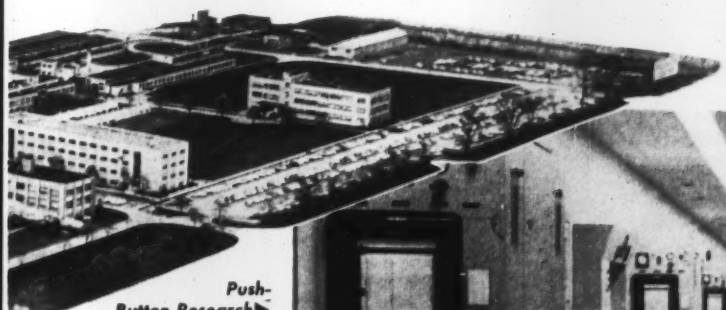
Autumn, 1958
International Conference on Gearing

Note: The foregoing calendar of The Institution of Mechanical Engineers' (Great Britain) meetings is published as a service to members of ASME. Further information relating to complete programs and available papers may be obtained from The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London, S.W.1, England. Preliminary programs also are published in *The Chartered Mechanical Engineer* (IMechE) which is on file in the Engineering Societies Library, 29 West 39th St., New York, N. Y., and other libraries throughout the United States and Canada.

New GULF Research Center



Three-Million Volt-Jolt is delivered by business end of Gulf's "atom smasher," central equipment of Nuclear Science Laboratory. The machine will be used to probe for new applications of nuclear energy to petroleum production, refining, and creation of new products. Samples to be irradiated will be rotated beneath the nuclear beam the scientist is examining.



Push-Button Research is symbolized by this corridor in the Automotive Products Lab. Room-size engine test cells—soundproof, vibration-proof, specially ventilated—evaluate fuels and lubricants.

ASME News

With Notes on Society Activities and Events

E. S. Newman, *News Editor*

First National ASME-AIChE Heat Transfer Conference to Be Held at Penn State

Thirty-five paper program to give wide coverage of field

PROGRAM plans for the First National Conference on Heat Transfer to be held August 12-15 at Pennsylvania State University, University Park, Pennsylvania, have been completed. This conference, jointly sponsored by the Heat Transfer Division of The American Society of Mechanical Engineers and the American Institute of Chemical Engineers, will be the first time that the two groups have co-operatively sponsored an independent technical program, although there have been joint symposiums presented at general Society meetings in the past.

The program includes 35 technical papers on a variety of topics, and inspection trips to the "swimming pool" nuclear reactor and the Naval Research Ordnance Laboratory at the University.

There will also be a series of industrial exhibits.

Guest of honor at a banquet on August 14 will be Prof. W. H. McAdams, Mem. ASME, for 43 years a member of the faculty of the Massachusetts Institute of Technology. Professor McAdams is known internationally for his pioneering work in heat transfer and his textbook in the field has been an authoritative work for over 30 years.

Most technical sessions will be held in the air-conditioned auditorium of the University's Hetzel Union Building.

A women's program has been planned which includes trips to local and campus points of interest. For the registrants who plan to bring their children, an activity program has been arranged.

Details of the program follow

▶ Monday, August 12

9:30 a.m. — **Assembly Room, Hetzel Union Building**

Session 1—Heat Exchangers

Chairman: *Myron Tribus*, College of Engineering, University of California, Los Angeles.

Vice-Chairman: *D. S. Cryder*, department of chemical engineering, Pennsylvania State University.

Study of Heat Transfer and Pressure Drop Under Conditions of Laminar Flow in the Shell Side of Cross-Baffled Heat Exchangers, by *F. L. Test*, College of Engineering, University of Rhode Island. (Paper No. 57—HT-3)

Dynamic Response of Heat Exchangers Having Internal Heat Sources, Part 2, by *Vedat S. Arpaci* and *John A. Clark*, Department of Mechanical Engineering, University of Michigan. (Paper No. 57—HT-6)

New Method of Heat-Exchanger Design, by *R. S. Fairall*, Garrett Corporation, Los Angeles, Calif. (Paper No. 57—HT-5)

2:00 p.m. — **Assembly Room, Hetzel Union Building**

Session 2—Heat Exchangers

View shows Hetzel Union Building, Pennsylvania State University, University Park, Pa., where the first national Conference on Heat Transfer will be held August 12-15. The conference is jointly sponsored by ASME and AIChE.

Chairman: *C. F. Bonilla*, department of chemical engineering, Columbia University

Vice-Chairman: *J. D. Decker*, department of mechanical engineering, Pennsylvania State University

Heat Transfer to Liquid Metals, by *P. S. Lykoudis* and *Y. S. Touloukian*, department of mechanical engineering, Purdue University (Paper No. 57—HT-16)

Heat Transfer to Fluids With Low Prandtl Numbers for Flow Through Tube Banks, by *R. D. Cess* and *R. J. Grosh*, department of mechanical engineering, Purdue University (Paper No. 57—HT-12)

Heat-Transfer Rates to Cross-Flowing Mercury in a Staggered Tube Bank, Part 2, by *C. L. Richard, C. E. Dwyer*, Brookhaven National Laboratory, and *D. D. Dropkin*, Cornell University (Paper No. 57—HT-11)

2:00 p.m. — Room 119, Osmond Laboratory

Session 3—Conduction

Chairman: *R. H. Norris*, General Engineering Laboratory, General Electric Company, Schenectady

Vice-Chairman: *M. W. Rosenthal*, Oak Ridge National Laboratory, Oak Ridge, Tenn

Quasi-Linear Heat Flow, by *N. E. Friedmann*, Litton Industries, Beverly Hills, Calif. (Paper No. 57—HT-10)

Influence of Gradient Temperature Fields on Thermocouple Measurements, by *N. R. Johnson, A. S. Weinstein*, and *F. Osterle*, department of mechanical engineering, Carnegie Institute of Technology (Paper No. 57—HT-18)

Effectiveness of Stub Fins as Determined by the Teledeltos Paper Analog, by *F. Landis* and *T. Zupnik*, department of mechanical engineering, New York University (Paper No. 57—HT-20)

▶ Tuesday, August 13

9:30 a.m. — Assembly Room, Hetzel Union Building

Session 4—Furnaces and Boilers

Chairman: *G. C. Williams*, department of chemical engineering, Massachusetts Institute of Technology

Vice-Chairman: *J. Kestin*, Brown University

Radiant Heat Exchange in a Gas-Filled Enclosure, by *H. C. Hottel* and *E. S. Cohen*, Massachusetts Institute of Technology (Paper No. 57—HT-23)

Heat-Transfer Studies of Naval Boilers, by *L. Cohen* and *W. A. Fritz, Jr.*, U. S. Naval Boiler and Turbine Laboratory, Naval Base, Philadelphia (Paper No. 57—HT-8)

9:30 a.m. — Room 119, Osmond Laboratory

Session 5—Inside Ducts

Chairman: *E. R. G. Eckert*, department of mechanical engineering, University of Minnesota

Vice-Chairman: *J. N. Addoms*, Atlas Powder Company, Wilmington, Del.

Experimental Velocity and Temperature Profiles for Air in Turbulent Pipe Flow, by *C. A. Sleicher, Jr.*, Shell Development Company, Emeryville, Calif. (Paper No. 57—HT-9)

Heat Transfer and Pressure Drop in Odd-Shaped Annuli, by *C. Johannes* and *R. R. Kraybill*, University of Rochester (Paper No. 57—HT-26)

Momentum and Mass Transfer by Eddy Diffusion in a Wetted-Wall Channel, by *A. M. Dhanak*, General Electric Company, Schenectady, N. Y. (Paper No. 57—HT-32)

2:00 p.m. — Assembly Room, Hetzel Union Building

Session 6—Inside Ducts

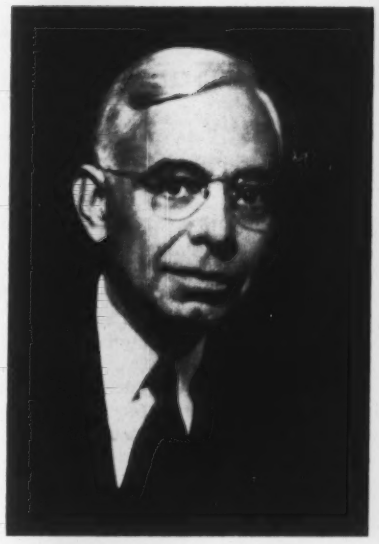
Chairman: *G. T. Skaperdas*, M. W. Kellogg Company, Jersey City, N. J.

Vice-Chairman: *R. M. Drake*, department of mechanical engineering, Princeton University

Combined Free and Forced Convection in a Constant Temperature Vertical Tube, by *T. W. Jackson, W. B. Harrison*, and *W. C. Boteler*, department of mechanical engineering, Georgia Institute of Technology (Paper No. 57—HT-13)

Gas Friction and Heat Transfer in Ducted Flows, by *S. V. Manson*, Research Division, Curtiss-Wright Corporation, Clifton, N. J. (Paper No. 57—HT-34)

Heat Transfer to Super-Critical Water, by *N. L. Dickinson* and *C. T. Welch*, The Babcock & Wilcox Company, Alliance, Ohio (Paper No. 57—HT-7)



W. H. McAdams, Mem. ASME, whose text, "Heat Transmission," spread his fame internationally, will be honored at the first national Conference on Heat Transfer, Pennsylvania State University, August 12–15

Convective Heat Transfer from High-Temperature Air Inside a Tube, by *H. E. Zellnick* and *S. W. Churchill*, University of Michigan (Paper No. 57—HT-33)

7:00 p.m. — Nittany Lion Inn

Banquet in honor of Professor W. H. McAdams

▶ Wednesday, August 14

9:30 a.m. — Assembly Room, Hetzel Union Building

Session 7—Miscellaneous

Chairman: *H. B. Nottage*, Propulsion Research Laboratory, Santa Monica, Calif.

Vice-Chairman: *C. A. Walker*, department of chemical engineering, Yale University

Modes of Adiabatic and Diabatic Fluid Flow in an Annulus With an Inner Rotating Cylinder, by *J. K. Kaye* and *E. C. Elgar*, Massachusetts Institute of Technology (Paper No. 57—HT-14)

Heat Transfer in Internal-Combustion Engines, by *C. Fayette Taylor* and *Tan-Yi Toong*, department of mechanical engineering, Massachusetts Institute of Technology (Paper No. 57—HT-17)

Heat Transfer in Thin Film, Centrifugal Processing Units, by *A. R. Gudheim*, The Kontro Company, Mass., and *J. Donovan*, Artisan Metal Products Company, Waltham, Mass. (Paper No. 57—HT-22)

9:30 a.m. — Room 119, Osmond Laboratory

Session 8—Two-Phase

Chairman: *M. T. Cichelli*, Engineering Research Laboratory, E. I. du Pont de Nemours and Company, Inc., Wilmington, Del.

Vice-Chairman: *F. F. Buckland*, General Engineering Laboratory, General Electric Company, Schenectady, N. Y.

On the Stability of Boiling Heat Transfer, by *H. Zuber*, Department of Engineering, University of California, Los Angeles (Paper No. 57—HT-4)

Bubble Growth Rates in Boiling, by *Peter Griffith*, department of mechanical engineering, Massachusetts Institute of Technology (Paper No. 57—HT-2)

Correlation of Nucleate Boiling Burnout Data, by *Peter Griffith*, department of mechanical engineering, Massachusetts Institute of Technology (Paper No. 57—HT-21)

Film Boiling From a Vertical Tube, by *V. Y. Hsu* and *J. W. Westwater*, department of chemistry and chemical engineering, University of Illinois (Paper No. 57—HT-24)

2:00 p.m. — Assembly Room, Hetzel Union Building

Session 9—Two-Phase

Chairman: *J. F. Wachunas*, Research Laboratory, The Babcock & Wilcox Company, Alliance, Ohio

Vice-Chairman: *W. E. Kuns*, department of engineering research, Pennsylvania State University

Wetting Effects on Boiling Heat Transfer: The Copper-Stearic Acid System, by *W. B. Harrison* and *Z. Levine*, School of Mechanical Engineering, Georgia Institute of Technology (Paper No. 57—HT-29)

Experimental and Analytical Study of Two-Phase Two-Component Flow in an Ejector With Condensation, by *Joseph Kaye* and *Miguel A. Rivas, Jr.*, Massachusetts Institute of Technology (Paper No. 57—HT-35)

Heat Transfer From Superheated Vapors to a Horizontal Tube, by *Garen Balekjian* and *D. L. Katz*, University of Michigan (Paper No. 57—HT-27)

Horizontal Condenser Theory I—Mathematical Development of Tube Loading, by *D. Q. Kern*, D. Q. Kern Associates, Cleveland, Ohio (Paper No. 57—HT-28)

▶ Thursday, August 15

9:30 a.m. — Assembly Room, Hetzel Union Building

Session 10—Miscellaneous

Chairman: *S. W. Churchill*, University of Michigan

Vice-Chairman: *J. G. Richter*, department of mechanical engineering, Pennsylvania State University

Control of Flow Sensitivity by Mixing Headers, by *S. C. Hyman, A. R. Gruber*, and *Leon Joseph*, Nuclear Development Corporation of America, White Plains, N. Y. (Paper No. 57—HT-30)

Heat Transfer in a Round Tube With Arbitrary Velocity Distribution, by *L. R. Whiteman*, engineering department, University of California, Los Angeles, and *W. B. Drake*, Lockheed Aircraft Corporation, Van Nuys, Calif. (Paper No. 57—HT-1)

Natural Convection Heat Transfer in Regions of Maximum Fluid Density, by *R. S. Schechter* and *H. S. Eibin*, department of chemical engineering, University of Minnesota (Paper No. 57—HT-25)

9:30 a.m. — Room 119, Osmond Laboratory

Session 11—Fluidization and Porous Walls

Chairman: *W. M. Raksenow*, department of mechanical engineering, Massachusetts Institute of Technology

Vice-Chairman: *J. W. Hoopes, Jr.*, Atlas Powder Company, Wilmington, Del.

Heat, Mass, and Momentum Transfer in Flow Through Porous Media, by *Leon Green, Jr.*

Papers by Mail

ONLY numbered ASME papers in this program are available in separate copy form until June 1, 1958. Copies can be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Prices are 25 cents to members of ASME, 50 cents each to nonmembers. Papers must be ordered by the paper number listed in this program, otherwise the order will be returned. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the Conference.

Aerojet-General Corporation, Azusa, Calif. (Paper No. 57—HT-19)

Heat Transfer Between Fluidized Solids Beds and Boundary Surfaces—Correlation of Data, by *L. Wender* and *G. T. Cooper*, M. W. Kellogg Company, New York, N. Y. (Paper No. 57—HT-31)

▶ Women's Program

Ladies are invited to attend all the events on the Social Program. In addition, the following program has been arranged

Monday, August 12
10:00 a.m.
Tour of Mineral Industries museum and lecture on the manufacture of chinaware, by *Prof. F. A. Hummel*

Tuesday, August 13
10:00 a.m.
Trip to Penn's Cave and Luncheon (ticket required)

Wednesday, August 14
10:00 a.m.
Tour of State College Homes in modern architecture.

ASME Power Conference, Allentown, Pa., Oct. 21–23

THE Anthracite-Lehigh Valley Section of The American Society of Mechanical Engineers will be host to the first National Power Conference to be held outside of New York City, on October 21–23. Headquarters for the Conference will be the Americus Hotel in Allentown, Pa. Prominent engineers from all parts of the United States will attend this conference.

The program will include papers by qualified speakers on such subjects as industrial power and cooling tower applications; outdoor power plants for cold climates; controlled starting of high-pressure turbines; effect of heated river water on aquatic life; a new power station designed to include an axial flow turbine, side entry condenser, monotube boiler, and a new type combustion control; turbine and generator rotor failures and developments; and nuclear power developments.

Inspection trips through the Bethlehem Steel Plant and the Martins Creek Power Plant are scheduled for Tuesday afternoon October 22. Special entertainment, including a tour of historical Moravian buildings in Bethlehem, is being arranged for the women who will be guests at the conference and they are also invited to go on the plant inspection trips.

An early bird social hour is scheduled between 4:00 and 6:00 p.m. Sunday, October 20, and there will be a Smorgasbord Dinner Monday evening, October 21. W. F. Ryan, ASME President, will be the guest speaker at the banquet on Tuesday evening, October 22. Special entertainment will also be provided at the banquet by a quartet from Lafayette College.

O. B. Schier, 2nd, Named Secretary-Elect at ASME San Francisco Meeting

O. B. SCHIER, 2ND, has been designated secretary-elect of The American Society of Mechanical Engineers by unanimous vote of the Society's Council, it was announced June 14 by Dr. William F. Ryan, ASME President. He will succeed Clarence E. Davies who will retire as secretary after 23 years of service in this office. The post of Secretary is the chief administrative office of the Society.

The announcement came at the close of the ASME Semi-Annual Meeting which began on June 10, and closed June 14 at the Sheraton-Palace Hotel in San Francisco, Calif.

Mr. Schier, 49 years of age, has been a member of the Society since 1932, and a member of the staff in various capacities for the past 11 years. He was elected assistant secretary in 1953 and advanced to the post of deputy secretary last December. He was graduated from Lehigh University in 1929 with the ME degree, and received his master's degree from the same University the following year. He was formerly associated with the Consolidated Edison Company of New York, and held the rank of lieutenant in the U. S. Navy during World War II.

A resident of Huntington, Long Island, N. Y., Mr. Schier is married and has one daughter.

O. B. Schier, 2nd, named secretary-elect of ASME at 1957 Semi-Annual Meeting in San Francisco

OGP CONFERENCE AND EXHIBIT

Residual fuels, diesel design considerations, piston rings, engine operation, turbocharger development, and engine analyzers discussed at Louisville meeting

"Piston Rings for Oil and Gas Engines" was the topic of the panel discussion, *below*, one of two at the conference. Among those who presented papers were, *top* to *bottom* at left: John D. Hines, Mem. ASME, "Turbocharger Development for Loop-Scavenged Two-Cycle Gas Engines"; Kurt F. Froehlich, Mem. ASME, "Sizing of Centrifugal Separators for Residual Fuels"; E. Eugene Ecklund, on an engine analyzer; E. N. Henderson, on gas pulsation; W. F. May, on compressor cylinder cooling requirements.

TRIAL-AND-ERROR methods for the operation and maintenance of oil and gas engines are outmoded by the testing devices and improvements described and shown at the 29th annual ASME Oil and Gas Power Conference and Exhibit at Louisville, Ky., May 20-23, 1957.

Electronic analyzers which indicate ignition and compression defects, or graphically portray the effects of gas pulsation; conditioners for air intake to promote maximum operating efficiency; and the contribution of proper piston rings were all considered in relation to engine function. Two sessions also were devoted to the use of residual fuels for diesel engines.

The attendance at the four-day sessions was 475 with an unusually good percentage of wives present. In addition to the technical sessions, there were luncheon and banquet programs, inspection trips to several of the American Air Filter Company plants and to the Jeffersonville Boat & Machinery Company. Exhibitors' social hours and a river-barge trip provided ample opportunity to savor Southern hospitality and food.

Luncheon and Banquet

A. G. Rosenbaum, Mem. ASME, general superintendent, Louisville Gas & Electric Company, was the toastmaster at the Welcome Luncheon, where the welcoming address was delivered by K. P. Vinsel, executive vice-president, Louisville Chamber of Commerce.

ASME President William F. Ryan spoke on "The Professional Division," commenting that few members have any concept of the scope of The American Society of Mechanical Engineers. The first few years that he was a member, he "thought that the Power and Applied Mechanics Divisions were the ASME, but as a member of the Publications Committee, I began to get an idea of the tremendous breadth and depth of the organization."

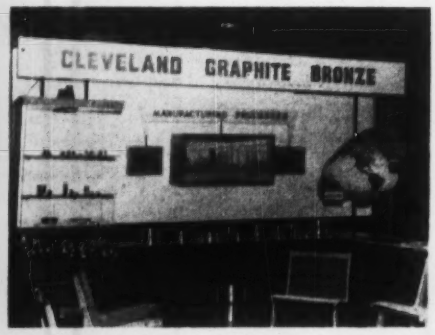
the current work undertaken by DEMA.

William Leonard Hunt Doyle was made a Fellow ASME. Arthur Stearns Hawks, Fellow ASME, received an OGP Citation for Outstanding Service at the banquet. OGP Speakers' Awards were presented.

Frank G. Dickey, president of the University of Kentucky, spoke at the banquet on "Our Debt to Dreamers," suggesting that we owe much to "the dreams of gifted persons with mental horizons beyond the rest of us."

Dr. Dickey said there are three outstanding qualities that characterize Americans: The driving force of a great dream; the conviction that nothing is impossible when men are free; and constant readiness for change. "We are," he said, "a nation which permits men to have dreams, and allows them the freedom to make them become reality."

He also advocated higher salaries for teachers.



Thirty-one exhibitors participated in the exhibit portion of the 1957 Oil and Gas Power Conference and Exhibit. The various components of oil and gas power systems, fuels, filters, noise-control equipment, temperature-measuring and controlling instruments, and alloy metals were shown. In addition, the exhibitors sponsored buffet luncheons and daily

The Oil and Gas Power Division, for example, is healthy indeed, President Ryan stated, when people come from Seattle, Los Angeles, Dallas, El Paso, Tulsa, and Milwaukee, as well as from all over the East to discuss a broad range of subjects on both stationary and marine applications.

President Ryan also stated that he hoped the engineers present were as enthusiastic about their Section as they had demonstrated themselves in regard to their Division. The Society is democratically run; every member has an opportunity to contribute and to make suggestions. Conferences of Regional Delegates and Technology Executives consider what the Society is doing, what it should do, and all suggestions are evaluated carefully.

At the banquet, Walter A. Rentschler of the Baldwin-Lima-Hamilton Corporation, and president of the Diesel Engine Manufacturers Association, was toastmaster. He also described some of

OGP Exhibit

The various components of oil and gas power systems and pertinent ASME publications were on display in the 31 booths of the Kentucky Hotel's exhibition hall. Conferees had an opportunity to see a number of the products and devices that were the topic of technical papers. A model of the *M. V.* Lachlan Macleay was exhibited; the quadruple-screw towboat was the site of a number of tests of vapor-phase cooling as well as the dual-fuel system use of distillate fuels, as outlined in a paper by E. Renshaw and Roy N. Larson of St. Louis Shipbuilding & Steel Company.

Other exhibits which paralleled paper topics were engine-test equipment, chrome plating, piston rings, and intake-air filters. In addition, there were displays of an opposed-piston diesel, other engines and machinery, metals and alloys, oil filters, automotive electrical products, diesel fuel-injection equipment, governors, noise-control equipment, bearings, bushings, and allied equipment, roller chains and sprockets, turbochargers and superchargers, and various instruments and controls.

Technical Sessions

Among the most lively discussions at the meeting were two sessions on the use and adaptation of residual fuels for diesel application, and panel discussions on piston rings for oil and gas engines. Engine intake-air conditioning also created a good deal of interest.

Lee Schneitter, Fellow ASME, mechanical engineer, Ebasco Services, Inc., delivered the OGP Special Lecture, surveying the entire literature on "Residual Fuels for Diesel Engines" of 500 rpm or less. Pointing out that the fuel bill is the largest operating expense, exclusive of fixed charges, and accounts for 63 to 72 per cent of the annual costs, he stated that the change to lower cost residual fuels may be the salvation of diesel as a power source. Although the refining trend is toward the reduction of the proportion of residual fuels, the total quantity has remained constant because of the over-all increase in petroleum production. Metallic contaminants, viscosity variations, high sulfur, and ash, all contribute to engine problems. Adequate filtration, and continuous heating of heavier fuels from storage to engine to reduce viscosity and increase volatility, and the use of well-cooled fuel spray nozzles, as well as alloy cylinder liners, can all contribute to efficient operation.

Centrifuges are one of the most effective means of treating residual fuels, but

there are problems in selecting the proper size and type of centrifuge, as considered by Kurt F. Froehlich, Mem. ASME, Nordberg Manufacturing Company. Keeping the centrifuges clean is particularly important and related to capacity. In the discussion, W. J. Fritton, U. S. Rubber Reclaiming Company, Inc., recommended the use of U. S. Navy specifications on centrifugal purifiers as an aid to capacity determination. G. P. Bronisch, Centrico, advocated the development of a precise method from Mr. Froehlich's proposal.

The use of diesel fuels on river towboats has been referred to in discussing the exhibits. The cost of combined vapor-phase, centrifuge, and Nemec dual-fuel system modifications were paid for in a single year from the savings in fuel.

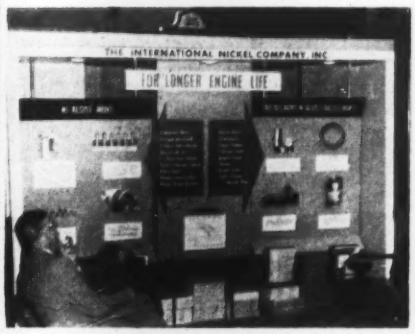
Conditioning engine-intake air permits peak performance at ideal temperature and humidity conditions, the kind you get from your car on cool humid summer evenings. In more precise terms, it permits the leveling out of the diesel fuel-consumption curve for increased operating temperatures, and the reproduction of ideal temperature and humidity conditions at any altitude.

The discussion on piston rings refuted the charges of one engineer that there had been no advances in piston rings in 50 years. Exact determination of the number and types of compression and oil-control rings, application of statistical control to inspection procedures, the value of chrome plating, and variations in form were all discussed. The trend is definitely to a narrower, higher strength ring. One type of conformable oil and compression ring prevents blowdown, and controls oil at the same time. Oil film in modern rings is microscopic, being reduced to 47 billionths of an inch. A single molecule is the ideal, since it reproduces the temperature of the cylinder wall, whereas additional layers act as insulation. This thinning of the film has resulted in the fantastically low gas-engine consumption of lube in some cases of only 35,000 hp-hr per gal of oil, with 18,000 fairly common.

Almost as lively interest was shown in the papers on enginescopes and other devices for studying engine operation described in papers by E. E. Ecklund of Allen B. Dumont, Inc., and H. E. Fisher and Vernon Miles of Sperry Gyroscope Company. The oscilloscope is the basic component. It gives either a parade or multiline presentation to indicate the ignition pattern. Variations in pattern can be interpreted as specific defects which are easily located. Compression and vibration problems can be diagnosed.

A similar but much more complex device is the compressor-station analog, developed by the Southern Gas Association's Pulsation Research Council, and outlined in a paper on gas pulsations by E. N. Henderson, chief engineer, Arkansas Louisiana Gas Company. The multipanel analog permits a complete analysis, from the face of the compressor piston, through every foot of piping. The effects of varying operating conditions including compression ratios, pocket operation, crank-angle relationships, piping configurations, and many other components can be evaluated individually and as a system. Central to the interpretation, is a compressor "card," a distorted rectangular outline reproduced on the oscilloscope, in which flutter of any of the four lines is indicative of load, capacity, or waste variations.

Three other papers dealt with the design considerations in engine development. The evaluation of chromium plating was described by R. W. Reynolds, of the U. S. Naval Engineering Experiment Station. "Turbocharging Development for Loop-Scavenged Two-Cycle Gas Engines," was the subject of a paper by J. D. Hines, Mem. ASME, and N. Reed of the Cooper-Bessemer



social hours for conference attenders. Paper topics were paralleled by several, and it was possible to view engine air-intake conditioning systems, the vapor-phase system as installed, and an additional system of engine analysis.

Frank G. Dickey, president, University of Kentucky, spoke on "Our Debt to Dreamers" at the banquet. Seated, *left to right*, Louisville Chairman Frank M. Kilroy; George J. Dashefsky, Fellow ASME; W. L. H. Doyle, Fellow ASME; Division Chairman P. B. Jackson.

Corporation. "An Appraisal of Compressor-Cylinder Cooling Requirements" was presented by W. F. May and A. G. Clark, both Mem. ASME and from the Ingersoll-Rand Company.

A study of "Variations in Marine-Engine Performance with Departures from the Design Conditions of the Propeller," brought out the harmful effect of overload, and the suggestion that engines should be powerful enough to operate without overload, although other discussors suggested that cost considerations would not favor such surplus power. Torque-limiters or other governing devices were also frowned upon because of the occasional need for excess power operation to avoid collision with bridge piers or other fixed objects, and their general hampering effect on maneuverability.

All papers presented at the OGP Conference, with the exception of the OGP Special Lecture, were available and are abstracted in the "Technical Digest" section of this issue of MECHANICAL ENGINEERING. An Oil and Gas Power Proceedings will be published in the fall.

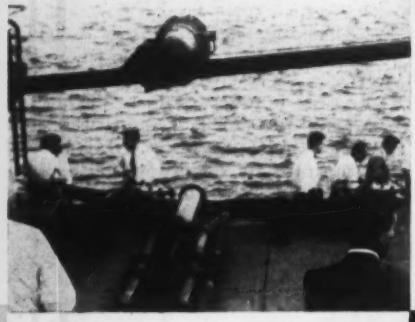
Availability List— Oil and Gas Power Papers

THE papers in this list are available in separate copy form until March 1, 1958. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Paper No.	Title and Author
57—OGP-1	An Appraisal of Compressor-Cylinder Cooling Requirements, by W. F. MAY and A. G. CLARK
57—OGP-2	Variations in Marine-Engine Performance, by F. C. VIBRANS, JR.
57—OGP-3	A Study of Industrial-Engine Operation, by H. E. FISHER and V. H. MILES
57—OGP-4	Turbocharging Development for Loop-Scavenged Two-Cycle Gas Engines, by J. D. HINES and N. REED
57—OGP-5	Effect of Intake Combustion-Air Conditioning on Performance of Spark Ignition Gas Engines, by W. F. MACINNES and R. L. SOLNICK
57—OGP-6	Chromium Plating Development at the U. S. Naval Engineering Experiment Station, by R. W. REYNOLDS
57—OGP-7	A Practical EnginScope for Field Maintenance, by E. E. ECKLUND
57—OGP-8	Sizing of Centrifugal Separators for Residual Fuels, by KURT FROEHLICH
57—OGP-9	Gas Pulsations—The Problem, Southern Gas Association's Approach, and Results, by E. N. HENDERSON
57—OGP-10	The Use of Heavy Fuel in High-Speed Deisel Engines on River Towboats, by E. RENSHAW and R. N. LARSON

▲A second lively panel discussion considered the problem of engine intake air conditioning for maximum operating efficiency

▼River-barge building and repair facilities, and the largest inland dry dock in the country, were seen on an inspection trip to the Jefferson Boat & Machine Company



▲"Residual Fuels for Diesel Engines," the OGP Special Lecture, was delivered by Lee Schneitter, Fellow ASME

▼A canal trip on a converted river barge was an unprogrammed special attraction which included a steak dinner

▼Frank M. Kilroy, Assoc. Mem. ASME and chairman, Louisville Section, discusses the OGP Conference program with ASME President W. F. Ryan

View of the Hotel Statler, Hartford, Conn., headquarters for the 1957 ASME Fall Meeting. One also sees, from Bushkill Park, the State Government buildings, Library, Armory, and others. The hotel is within walking distance of rail and bus transportation and service by the airlines at Bradley Field, Windsor Locks, Conn.

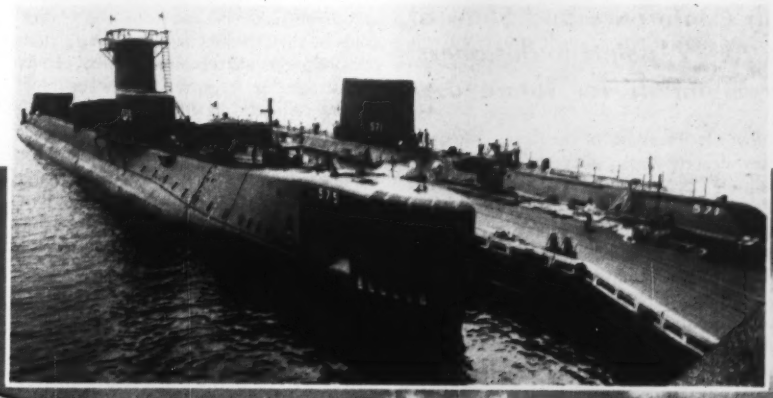
1957 ASME Fall Meeting

Hotel Statler
Hartford, Conn.
September 23–25

The technical program will include papers on production engineering, machine design, aviation, gas turbine power, and many more.

Two of the inspection trips are highlighted in the photos on this page. Another trip to the Sikorsky plant of United Aircraft Company, Stratford, Conn., is presently in the planning stage.

Two of a Kind. Photo shows the Navy's two nuclear-powered submarines at the dock of their builder, the Electric Boat Division of General Dynamics Corporation, Groton, Conn. The *USS Nautilus* (571) was in for postshakedown repairs, while the *Seawolf* (575) is being fitted out following her launching.



Schaefer's Spouter Tavern and the *Charles W. Morgan*, last of the wooden whale ships, as seen through the gateway to the old burial ground at Mystic Seaport, a 19th century Connecticut coastal village

View of exhibitors' booths at Design Engineering Show held at New York Coliseum, New York, N. Y., May 20–23. 371 companies displayed more than 10,000 products, materials, and components.

Design Engineers Seen in New Role

ASME Design Engineering Conference and Show at New York Coliseum, May 20–22, points to designers' work changes and new materials for future uses

New developments, new designs, new products—these were the phrases most often heard at the Design Engineering Conference held at the New York Coliseum, New York, N. Y., May 20-22. The conference, sponsored by the Machine Design Division of The American Society of Mechanical Engineers in cooperation with the ASME Metropolitan Section, was held in conjunction with the Design Engineering Show.

All speakers at the opening panel of the conference agreed that the proportion of gross sales volume now being reinvested for new product development by American companies is at a record high. In this era of creative and original designs, the role of the designer is also undergoing basic changes. Originally considered merely as styling consultants, today's designers are being used to save costs of manufacture and to improve the function of the products.

Twelve speakers, who addressed a total of 1750 registrants, illustrated not only the new achievements in the mechanical, electrical, and materials fields; but also the design engineer in his new role.

Gear Design Developments

The development of a new product is most often a result of the development of new designs and applications of the parts which comprise the total product. Gears, a tool of the engineer since the age of the Ancient Egyptians, have always received much attention. In a review of recent developments in the field of gear design, the factors used in gear-rating equations were discussed. These factors may be divided into two classifications—prime factors and derating factors. Prime factors are positive quantities such as diametral pitch, pitch diameter, face width, tangential force, geometric shape of tooth, ratio, and so forth. Derating factors are factors which reduce capacity because of some lack of perfection in quality or accuracy. As design formulas grow more complicated there is a tendency to make greater use of handy indexes to size a gear drive. Spur and helical gears can be sized quite easily by the indexes of Q-factor, K-factor, and Unit Load.

Cam Design

Further illustration of the ability of a part to increase the performance of the whole product was presented in a discussion of new developments and design applications of cams. In attempting to solve the problem of running machines faster, it is necessary to know that maximum speeds of machines sometimes are determined by performance limitations of the cam mechanism used in their construction. Acceleration limits, choice of cam contour, required profile accuracy, and manufacturing methods need to be known in designing cams for high-speed mechanisms and industrial machinery. Comparisons between actual and theoretical acceleration curves were shown. A dynamic design limit was established as a guide in the development of new machines.

Importance of Design

The importance of the design of a single part was discussed again in relation to the new developments created by automation. One of the barriers which hamper the mechanization of productive processes in the manufacturing industries involves the limitations imposed by the design of the product being processed. Product designers are aware of the fact that the amount of machining involved in the manufacture of a component can raise costs. A part, well designed from the standpoint of assembly, will usually be easy to store, handle, machine, and keep well within the cost frame. For this reason, these problems should be considered early in any design project and receive as much consideration as the function and styling of the product.

A discussion of hopper-feeding illustrated the importance of the part designed with automatic processing equip-

ASME Design Engineering Conferees' panel discusses "Procedures in Developing New Designs." More than 1700 registrants attended mechanical, materials, and electrical sessions during the three-day conference.

ment in mind. Of approximately 12 separate types and concepts of feeding devices, five are best known: vibratory bowl-type feeders, rotary mechanical hoppers, elevating conveyer types, centerboard feeders, and centrifugal feeders. The proper type of feed can be determined by rate of feed, general toolability, and area for installation. A basic characteristic of all feeders is that they work with parts in a track. The automation project should not be endangered by short cuts or false economies on the design, selection, or installation of the track.

The development of new materials which have preceded and often inspired the development of new products was the subject of two sessions. Metallic materials; ceramic and refractory materials; plastics and rubbers; and coating and finishes; their properties, and their uses in new products were described. An article based on the presentations at these sessions will appear in MECHANICAL ENGINEERING in another issue.

Technical Sessions in Other Fields

At electrical sessions held on both mornings of the conference, numerical controls; designing machine tools for automatic controls; static switching devices; and new motors with National Electrical Manufacturers Association frame sizes were discussed. The following were among the many salient ideas which emerged from the discussions:

In designing machine tools for automatic controls, a systems concept must prevail and integrated design becomes a necessity. Applications particularly suited for static switching control are characterized by one or more of the following requirements: extreme reliability, reduced and simpler maintenance, high speed with many switching operations, reduced space requirements, and the safe operation in hazardous atmosphere.

As a result of rerating and standardization programs by NEMA new a-c and d-c motors which can be applied to motor-driven equipment can effect improvement in performance, economies in first cost and operation, improved appearance, reduction in size, and other benefits.

Proceedings of the Design Engineering Conference are being prepared. As soon as it is available, copies may be purchased through the ASME Order Department, 29 West 39th Street, New York, 18, N. Y., for $4 a copy. Registrants at the Conference will receive one copy of the proceedings when published.

Banquet

Climax of the conference was a banquet at the Sheraton-Astor Hotel, New York, N. Y. Toastmaster for the evening, William H. Byrne, Vice-President, ASME Region II, presented George F. Nordenholt, Mem. ASME, and editor, *Product Engineering*, with an award for his efforts on behalf of the Design Engineering Conference. ASME President William F. Ryan, guest speaker at the banquet, in his address, "The Design of a Profession," cited the atomic bomb and the nuclear-powered submarine, American firsts, as examples of the achievement of American engineering. He, too, noted the changing role of the engineer, and made an appeal for the engineer's awareness of the duties and responsibilities of his profession.

Exhibits

The Design Engineering Show, produced by Clapp & Poliak, Inc., New York, exposition management firm, attracted over 15,000 visitors. More than 10,000 products, materials, and components, which go into the making of end products were displayed by 371 exhibiting companies.

One of the outstanding new developments among the exhibits was the introduction by Heintz Manufacturing Company, Philadelphia, Pa., of a chemical surface treatment for metals which, it is claimed, "provides a substitute for the strategic metal, tin."

Among other exhibits attracting the interest of many visitors were:

A new polyethylene resin, by E. I. du Pont de Nemours & Company, Inc., Wilmington, Del., which is said to resist sagging during the thermoforming process.

A vinyl cable for atomic energy installations was unveiled by B. F. Goodrich Chemical Company, New York, N. Y.

Although newer materials attracted much attention, many visitors were drawn to exhibits which showed surprising new uses for such standard products as glass, wood, and steel.

Wood Industries Conference Reveals Swing to New Core Materials, Assembly-Line Production

Piedmont-Carolina Section of ASME host to engineers from 82 firms at Winston-Salem meeting

At Winston-Salem, North Carolina's twin city, 160 engineers representing 82 industrial firms of the wood industry held a two-day conference, May 16–17. The meeting, sponsored by the Wood Industries Division of The American Society of Mechanical Engineers in cooperation with the ASME Piedmont-Carolina Section, drew engineers from 25 states, Washington, D. C., and Canada. W. F. Ryan, ASME President, attended sessions and, speaking at the banquet, delivered a challenging report on the objectives of the Society and the code of the engineering profession.

Ten technical papers were presented, exploring the engineering innovations with which the wood industry is meeting the problems of scarcity and competition.

History, Cigarets, Furniture

Historic Winston-Salem (Salem meant "peace") gave the visiting engineers two days of salubrious weather and engaging hospitality. One hopes George Washington enjoyed as thoroughly the two days he is reported to have spent at the Salem Tavern in 1791. Winston and Salem became a united city in 1913, the year of the birth of its most famous product, Camel cigarets. Today, the city is cigaret builder to smokers of Camels, Winstons, and Salems, and its woodworking industry is no longer dominant. But Winston-Salem lies in the geographic heart of the southern furniture region, an ideal gathering place for the men who face the growing technical problems of wood-products manufacture.

During two days of sessions, held in the ballroom of the Robert E. Lee Hotel, it was obvious that our wood industry faces a transition in which progressive management and extensive capital expenditures are imperative. To compete with plastics, decorative metals, and imported wood products, the makers of plywood must adopt the most advanced methods, the most modern electrical and mechanical production machinery.

New Materials, New Techniques

The need for better, more competitive products comes at a time when the better grades of lumber are becoming increasingly scarce. Under this pressure, the industry has turned to new fillers for plywood. Where, prior to World War II, sawdust and chips were burned as waste products, now they are being used as fillers for plywood slabs. Today we have chipboard, particle board, paper honeycomb, hollow cores—all practical and available.

During the discussion of one paper, the point was brought out that the new plywood fillers enable us to use, in furniture, the same forest product that has previously been useful only for the manufacture of paper. Summing up the state of the wood industry, Chester L. Babcock, Mem. ASME, of the Babcock Machinery Company, said, "It's a technical revolution. There will be spectacular developments, and this conference will speed the application of the new techniques."

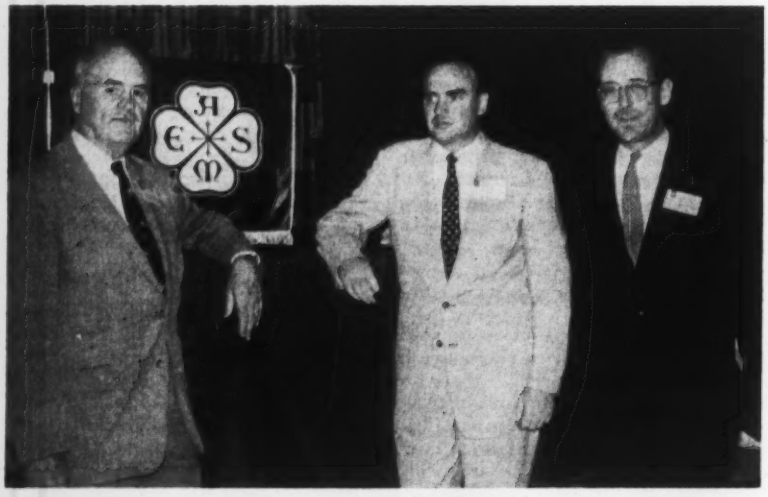
Of the ten technical papers, five took up various aspects of the new plywood cores. There was a report on paper honeycomb, in which paper is "blown up" to yield a much larger volume of low-density cellular structure. The liveliest and most protracted discussions followed papers on new automatic machines, factory conveyer systems, and accuracy—dimensional control—the latter resolving itself finally into the problem of humidity control in factories.

European Report

At the Thursday luncheon, high on the Balinese Roof of the Robert E. Lee Hotel, the conference heard a report on foreign wood industries from C. A. Rishell, vice-president of the Timber Engineering Company, Washington, D.C. Mr. Rishell had toured Europe as leader of a party of engineers from the furniture, lumber, and chemical industries, studying European methods, and developments in various types of boards. He and his party had found the most important advances in Germany.

"In 1954," he said, "80 per cent of the German furniture industry was using particle board in almost all its production. Today, it is nearly 100 per cent." He reported that Germany was producing $^3/_4$-in. particle board at a cost of $60 to $65 per 1000 sq ft.

Our own problem, he said, is to face up to the need for research. Who shall do the research? There is a tendency for the furniture people to put wood research off on the lumber companies, while lumber interests are inclined to feel it's the furniture-maker's problem. Actually, it's everybody's business. Whoever does it, we need at least $20 million of research during the next five years. Mr. Rishell cautioned against taking research lightly.



Between the acts at the Wood Industries Conference. ***Left to right,*** **C. L. Babcock (machinery), L. S. Inscoe (furniture), and T. D. Steinway (pianos) get together during a break in the Thursday session. Technical sessions were held, May 16–17, in the ballroom of Winston-Salem's Robert E. Lee Hotel.**

"People underestimate it," he said. "They make it seem easy. Then they go at it, and fail to get results."

Modern Factories

Engineers attending the conference had their choice of field trips to either of two modern furniture plants. Winston-Salem's first furniture plant was established in 1854 (it's still there, still in the same family), but from the viewpoint of the engineer the plant to see is that of the B. F. Huntley Company. It's a new brick-steel-and-concrete structure with an advanced type of finishing conveyer. Once assembled, a piece of furniture goes on a pallet and stays on it (except for polishing) all through finishing and up to shipping.

At the new plant of the Stanley Furniture Company, in Stanleytown, Va., visitors saw a windowless, completely air-conditioned, one-story plant designed for the efficient production of bedroom and dining-room furniture. The 251,000-sq-ft plant is "10 per cent pressurized," so that whenever a door is opened a current of air flows outward, preventing the ingress of dust. The new building has complete fluorescent lighting, and no trucks are used—all conveyers, including gravity rolls, belt conveyers, overhead monorails, and floor-type chain conveyers. Equipment includes fire-proof drying ovens and Stanley's own design of spray booths.

The Meeting Ground

President Ryan addressed the conference at the banquet. Like the luncheon, the banquet took place at the Balinese Roof of the hotel, with the city spread handsomely below and the breeze bringing the pleasant scent of tobacco from the cigaret factories. T. C. Heyward, Jr., chairman of the ASME Piedmont-Carolina Section, welcomed the visiting engineers and their wives; and then J. H. Sams, vice-president of ASME Region IV, introduced President Ryan.

The President viewed furniture making as an art, with engineering as an important implementing factor.

"Communication," he said, "is vital to the ASME's success, and it is in precisely this department that we fail. It is a general failure, one that prevents our having the spread of membership we should have, particularly the enrollment of young men. Contact between old and young engineers is the most valuable thing the Society has to offer. It was so when I was young, and it's so now."

He urged his listeners to see that their companies paid the way of their younger men to the next WID meeting in Syracuse, N. Y.

The Professional Engineer

Dr. Ryan then brought out the theme that is so important to him as ASME President, a theme he is repeating at every opportunity. It is his belief that the engineering profession must review its own attitudes and practices, and develop a new statement of its professional code. We need a survey such as the medical profession undertook in 1910.

"Today," he said "there is no doubt who is a doctor, a nurse, a pharmacist. Now, we need such a study, and maybe we can then classify ourselves. Suppose engineers performed only engineering as doctors practice medicine! We might even find there were enough of us."

Although we are ahead of any other nation in engineering progress, we are not up to standard as professional men. Dr. Ryan wants our professional activities better understood. He sees a great need for more communication with potential engineers through the ECPD,[1] starting in high school and continuing through to full professional life. He wants graduates to take the necessary examinations to register as engineers. He has high hopes for our professional development.

"We must understand our own code," he said, "and we must make it known."

At the banquet, ASME President W. F. Ryan addresses the conferees. Seated, *left to right*, are J. H. Sams, T. C. Heyward, Jr., W. B. Wilkins, C. L. Babcock, G. H. Ladd, and A. C. Thies, all members of the ASME who have been active in the affairs of the WID or of Region IV.

Availability List—Wood Industries Papers

THE papers in this list are available in separate copy form until March 1, 1958. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Paper No.	Title and Author
57—WDI-1	Finishing Controls at Drexel Furniture Company, by N. C. HATCHER, JR.
57—WDI-2	Progressive Management in Plywood Manufacturing, by G. W. SMITH
57—WDI-3	Woodworking Accuracy, by H. B. PITTMAN, JR.
57—WDI-4	Paper Honeycomb Used for Core Materials at the Brunswick-Balke-Collender Company, by R. A. McKAY
57—WDI-5	Chipboard, the Superior Plywood-Core Material, by P. F. BRUSQUINI
57—WDI-6	Automatic Sanding, by L. G. BROWN
57—WDI-7	The Case for the Hollow Core, by RALPH CASSELMAN
57—WDI-8	Automatic Machining in Furniture Manufacture, by E. S. JOHNSON
57—WDI-9	Selection of Carbide-Tipped Saw Blades for Optimum Performance, by E. J. DOWER and W. E. OAKEY
57—WDI-10	Core Materials for Plywood—Standard Lumber Cores, by C. D. DOSKER and S. H. DURST

[1] Engineers' Council for Professional Development, Headquarters at 29 West 39th Street, New York 18, N. Y.

Lubrication Conference to Review Research Projects in October

Engineers whose interest is focused on the lubrications field, will hear and discuss the results of research projects at the fourth annual Lubrication Conference, jointly sponsored by the American Society of Lubrication Engineers and The American Society of Mechanical Engineers. The meeting will be held at the Royal York Hotel, Toronto, Ont., Canada, Oct. 7–9, 1957. As plans begin to take shape, it is expected that this year's conference will outdo last year's meeting at Atlantic City, N. J., which was attended by 400 engineers from all parts of the United States and Canada.

Tentative plans also indicate that special emphasis will be given to wear, high-temperature lubrication, fatigue in rolling contact bearings, and hydrodynamic lubrication. Wear will be the subject of two sessions—one of which will be a reporter-type session at which it is planned that selected papers from The Institution of Mechanical Engineers (Great Britain) Conference on Wear, scheduled to be held in London, England, October 1–3, will be given. Papers at this session will be briefly presented by a reporter thus leaving a maximum period of discussion. This type of meeting, practiced frequently in England, was tried for the first time at the Atlantic City conference last year. The success of this type of meeting largely depends on the papers having been read and studied by the discussers before the meeting.

As in previous years, there will be no conflicting sessions and those attending the conference can attend the presentation and take part in the discussion of all papers. Preprints of the papers will be available for all who register at the meeting.

ASME Codes and Standards Workshop

Lisbon Screw Threads Committee Report

By P. V. Miller[1]

The Committee on Screw Threads of the International Organization for Standardization (ISO) recently held its fourth meeting in Lisbon, Portugal, on the invitation of the Reparticao de Normalizacao, the Portuguese Member Body of ISO.

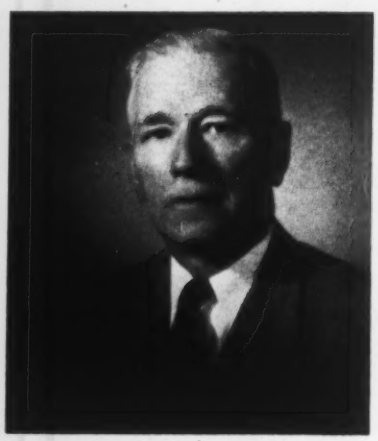
Several far-reaching resolutions were arrived at during the meeting. Among these decisions was the establishment of screw-threads series in inch and metric measure all having an identical triangular form of thread known universally as the ISO Basic Profile. While accepting these two parallel systems of screw threads, strong emphasis was placed on the importance of eventually developing from them a single series of screw threads for commercial bolts and nuts, which would have universal application. The future work of this international committee for screw threads will pay particular attention to this most important aspect of its work. The achievement of this aim would facilitate the interchangeability of commercial bolts and nuts manufactured in various countries, and if used extensively, the present difficulties of servicing mechanical commodities outside the country of origin would be eliminated.

More than 70 specialists took part in the three-day plenary meeting representing 22 countries including Austria, Belgium, Canada, Czechoslovakia, France, Finland, Germany, Hungary, India, Italy, the Netherlands, Poland, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States, and U.S.S.R. Australia, Bulgaria, and Rumania were represented respectively by the United Kingdom, Hungary, and the U.S.S.R. Mr. Miller and Spencer B. Terry represented American Industry at the conference.

The Secretariat of the Committee is handled by the Sveriges Standardiserings Kommission, the Swedish Member Body of ISO.

Dr. Hilding Tornebohm, Hon. Mem. ASME, former president of ISO, presided as he had in Paris in 1949; New York, 1952; and Stockholm, 1955.

[1] Manager, Small Tool Division, Taft-Peirce Manufacturing Company, Woonsocket, R. I. Fellow ASME.



H. W. Robb

H. W. Robb appointed ASME's representative on ASA Standards Council

Harry W. Robb, manager of company standards for the Engineering Division of the General Electric Company, a member of ASME since 1940, and former chairman of the Standardization Committee, has been appointed as the Society's third representative on the Standards Council of the American Standards Association. This brings the Society's representation up to full strength for the first time in 20 years. Serving with Mr. Robb as ASME representatives are: Granger Davenport of Gould and Eberhardt and P. V. Miller of The Taft-Peirce Manufacturing Company.

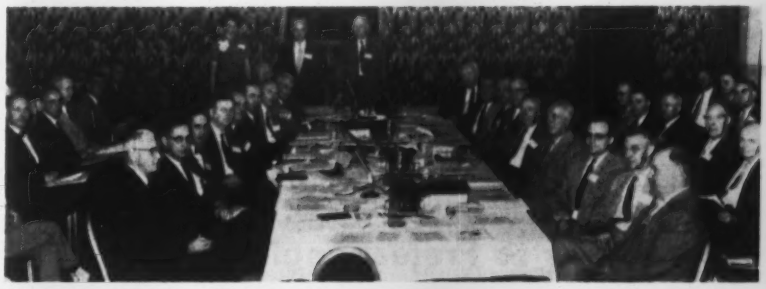
Boiler and Pressure Vessel Committee Texas Meeting

The 1957 out-of-town meeting of the ASME Boiler and Pressure Vessel Committee was held at the Rice Hotel, Houston, Texas, on May 1–3.

This meeting offered opportunity to those in the Houston and surrounding area to hear expert discussions of four different types of atomic power reactors, to present to a panel, experienced in all phases of ASME Code construction,

questions that arise in the daily use of the Code; to participate in meetings of the subcommittees and to follow through the recommendations of those subcommittees as they are presented to the ASME Boiler and Pressure Vessel Committee for decisions on proposed revisions to the Code and the adoption of Code Case Interpretations.

All sessions held in the three-day meeting were extremely well attended and an active interest was shown in all phases of Code construction, particularly that of Unfired Pressure Vessels.



View shows Boiler and Pressure Vessel Committee in session in Houston, Texas

Interpretations of 1955 Code for Pressure Piping

FROM time to time certain actions of the Sectional Committee B31 will be published for the information of interested parties. While these do not constitute formal revision of the Code, they may be utilized in specifications, or otherwise, as representing the considered opinion of the Committee.

Pending revision of the Code for Pressure Piping, ASA B31.1-1955, the Sectional Committee has recommended that ASME, as sponsor, publish selected interpretations so that industry may take immediate advantage of corresponding proposed revisions. Case No. 26 is published herewith as interim actions of Sectional Committee B31 on the Code for Pressure Piping that will not constitute a part of the Code until formal action has been taken by the ASME and by the American Standards Association on a revision of the Code.

Case No. 26

Inquiry: May Types 304 and 304L grades of stainless steel be used for piping in nuclear energy installations under the rules of Section 1 of the Code for Pressure Piping?

Reply: It is the opinion of the committee that Types 304 and 304L stainless steels may be used in nuclear energy installations for construction under Section 1, provided the following conditions are observed:

(1) The materials shall at least conform to one of the following specifications:

Pipe	A376
	A358
Welding Fittings	ASTM A403
Forgings	ASTM A182

(2) If welding is employed, all welds shall be fully radiographed.

(3) The design temperature shall not exceed 800 F.

Distributed at the ASME Booth at the Design Engineering Show. Copies available on request.

(4) The allowable stress values for seamless materials shall be as follows:

	Temperature F								
	−20 to 100	200	300	400	500	600	650	700	750 800
Type 304	18,750	16,650	15,000	13,650	12,500	11,600	11,200	10,800	10,400 10,000
Type 304L	17,500	17,000	13,400	11,000	9,700	9,000	8,750,	8,500	8,300 8,100

Note: These stress values do *not* include joint efficiency or quality factors.

(5) A joint factor of 0.95 shall be applied to welded construction that has been fully radiographed.

Junior Forum

Conducted for the National Junior Committee

By H. N. Weinberg,[1] Assoc. Mem. ASME

From Junior to Project Engineer

By Sydney H. Reiter[2]

EVERY junior engineer starting on his first job, looks ahead and asks himself, "How will I advance myself in the engineering profession?" Certainly no specific answer can be given to this question, but a discussion of the experience and qualifications necessary for advancement can be helpful in guiding the young engineer.

Experience for Advancement

Most engineers begin their careers as junior engineers. In this position, the usual assignment revolves about a single phase of an engineering project. The assignment may concern itself with testing a product for performance according to the design specifications. The junior engineer performs tests of various types, analyzes their results, and prepares a report.

Another type of assignment may concern itself with the design of a piece of equipment which is part of the project. The junior engineer makes the necessary calculations or chooses the proper components. He prepares or supervises the preparation of the working drawings. The final result of his efforts is all the information necessary to construct his design. This process is repeated over and over until the junior engineer and his fellow junior engineers complete all the phases of the project.

The junior engineer is concerned with only one phase of a project, devoting his entire efforts to its completion. These efforts are usually concentrated on the engineering aspects of his phase. Occasional supervision is supplied by the project engineer when a difficulty arises or when the direction of the junior engineer's efforts must be changed because of some other development. The viewpoint of the junior engineer is thus restricted to his own sphere of activity, assuring him the maximum concentration on his own phase.

While allowing him to devote all his efforts to his own particular assignment, this single-mindedness of purpose can also be the greatest stumbling block to the advancement of the young engineer. The reason for this statement becomes apparent when the duties of his next position, the project engineer, are examined

Project Engineer's Work

The project engineer is primarily a co-ordinator. When management has decided that a project is to be undertaken, it is assigned to a project engineer. His responsibility is to decide the basic form of the result, and to co-ordinate all the facilities of the company in order to successfully complete the project. His responsibilities are twofold: 1 He must exercise sound engineering judgment in directing his project; 2 he must co-ordinate the available personnel and facilities to complete the project on time within the budget allowance.

The first responsibility involves a high order of engineering proficiency. The project engineer must have broad knowledge of his area of engineering so that his solution of the assignment reflects the latest methods available. He must have sufficient experience to decide which of the methods will result in the most practical solution, and he must possess the quality of sound judgment in order to make proper decisions during the project when its direction and progress are in doubt.

The second responsibility is not associated with any engineering training, but involves a direct phase of management. The co-ordination of the project occupies the majority of the project engineer's energy and time after the project is under way. The personnel involved must be assigned their phases, and they must be constantly checked to insure that their work is proceeding according to schedule. Any delay by one group will cause the remainder to be delayed also, slowing the entire project. A running check must also be kept on the expenditure of funds so that the cost is kept within the allotted budget.

It is absolutely necessary for the project engineer to exercise control over many activities at the same time. To do so, his actions must be guided by an insistence upon sound, logical reasons for every step in the project. To allow slipshod methods will inevitably result in errors and poor engineering performance. Omissions and overlooking of small details have a habit of cropping up at critical moments, resulting in embarrassment and delay of the project. To compound these demands, every phase requires the same care, often producing a harrassed, frustrating sense of being lost in a storm of indecision and inaction. The ability to take each problem in turn, carefully advance its progress, and move on to the next problem, is the secret of the project engineer's success.

The project engineer is responsible for a part of his company's activities, making him a member of management. He needs to keep a finger on the company's pulse, being aware of the needs and interests of management. He can then contribute new ideas, guide his own project accordingly, and be ready to step into areas where more effort is needed.

My description of the duties of a project engineer may seem overwhelming to the junior engineer who is having a rough time pushing his phase to completion. Yet, his next advancement is not so difficult as it seems, providing he keeps his eyes open. His guiding principle should be to keenly observe the operation of his company and those around him, and then apply his observations to himself.

[1] Process engineer, Esso Research and Engineering Company, Linden, N. J.

[2] Project engineer, Charles Englehard, Inc., East Newark, N. J. Assoc. Mem. ASME

Sydney H. Reiter

Junior Engineer in Relation to Company

While conferring with his project engineer, the young engineer should observe how the project engineer organizes his work, and do likewise. He should learn about other areas of his company's operations. He should talk to members of the sales, accounting, purchasing, and production departments and find out how they function and how they are connected with the engineering department. Particularly, he should use every contact with management to learn as much as possible about the guiding principles of company operations.

As these areas become familiar to him, the young engineer will find himself thinking not only about his own phase each time a problem turns up, but also about how his problem affects other areas of company operations. Soon, he will instinctively enlarge his thinking so that he will be flexible enough not to see only one side of a problem. The lessons learned from working with the project engineer will allow the young engineer to efficiently organize his work so that prompt action is taken when required and no part of his phase is allowed to lag.

Breadth of view, insistence on thorough thinking, and organization of work will combine to produce the qualities of maturity which will enable the young engineer to be ready when the opportunity is presented, as it will be, for his advancement to project engineer.

Maintenance and Plant Engineering Group Has Plans

ASME's newest professional group, Maintenance and Plant Engineering, has already completed plans for an ambitious program of activities. A recent meeting of the Executive Committee of the group, held at headquarters in New York, N. Y., reviewed activities to date and plans for the future. These include co-sponsorship of several papers at the recent Semi-Annual Meeting in San Francisco, planned sponsorship of papers at the ASME Annual Meeting in December, and plans for a separate conference on Maintenance and Plant Engineering tentatively scheduled for April 14-15, 1958, at Pittsburgh.

Next meeting of MPE executive committee was scheduled for September 30 at the Pittsburgh (Pa.) Engineers Club.

State Boards for Engineering Registration

The following is a continuation of the list of State Boards responsible for professional engineering registration and the persons to whom inquiries should be directed.

Indiana State Board of Registration for Professional Engineers and Land Surveyors, Ferdinand Jehle, Secretary, 145 W. Washington Street, Indianapolis, Ind.

Iowa State Board of Engineering Examiners, W. G. Cunningham, Secretary, State House, Des Moines 19, Iowa.

Kansas State Board of Engineering Examiners, Mrs. Della Sterrett, Executive Secretary, 422 Garlinghouse Building, Topeka, Kan.

Kentucky State Board of Registration for Professional Engineers, C. S. Crouse, Secretary-Treasurer, University of Kentucky, Lexington 29, Ky.

Louisiana State Board of Registration for Professional Engineers and Land Surveyors, F. W. Macdonald, Executive Secretary, Civil Engineering Building, Tulane University, New Orleans 18, La.

Candidates for Membership and Transfer in ASME

The application of each of the candidates listed below is to be voted on after July 25, 1957, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and •Transfers

Arkansas

Gammill, William R., Pine Bluff
Shoemaker, James M., Pine Bluff

California

•Eaves, Hayden C., Jr., Alhambra
•Green, Leon, Jr., Azusa
Hsia, Henry T., San Jose
Jones, Kenneth L., Los Angeles
•Kline, Winfield S., Concord
Leeds, Harold J., San Francisco
Shoemaker, Robert M., Whittier

Connecticut

Colowitch, John M., Ansonia
Solomon, Robert, Norwalk

Delaware

Burkholder, John W., Wilmington

District of Columbia

Connolly, Anne J., Washington
Woods, Thomas A., Washington

Georgia

Adams, Richard D., Atlanta
Boswell, Edgar B., Atlanta

Illinois

Claussen, Lorenz V., Oak Park
Duchek, Ernest J., Chicago
Fainman, Morton Z., Morton Grove
Hersh, Ralph C., Jr., Chicago
Holvoak, Robert H., Dixon
Kereny, Tibor C., Chicago
Kilmartin, Ronald F., Chicago
Klemchuk, Henry J., Chicago
Strulrajter, Charles, Chicago
Wentworth, Robert B., Chicago
Zubek, Lawrence J., Oak Lawn

Indiana

Connor, Ralph F., Evansville
•Schoenberger, Robert L., Crawfordsville

Louisiana

McClelland, George D., Baton Rouge

•Transfer to Member or Affiliate

Maryland

Allen, Hillard H., Takoma Park
Harrington, William M., Jr., Pasadena
Hathaway, Gail A., Hyattsville
Nave, Frederic W., Frederick
Parsons, Robert E., Baltimore

Massachusetts

Budiansky, Bernard, Cambridge
Gross, Frank C., Wilbraham
Hawkins, Thomas D., South Boston
•Pinkus, Oscar, Lynn
Winther, Samuel R., Newtonville

Michigan

Kirkby, Robert C., Detroit
•Parkinson, Russell W., Jr., Livonia

Minnesota

Suplick, Stanley M., Minneapolis

Missouri

Frazer, Richard A., St. Louis

Nebraska

Seiler, Edwin N., Omaha

New Jersey

Pegram, William B., Clifton
Kazin, Hyman L., Newark
Mathews, Howard H., Jr., Waldwick
•Ratcliffe, Charles F., Pennsauken

New York

Baker, Earl A., Corning
Behan, William A., Hempstead
Bennett, Robert W., Corning
•Cantrell, Harry N., Schenectady
Cranch, Edmund T., Ithaca
Davis, Benjamin G., New Hartford
Hardin, Frederick W., New Hartford
Heller, Paul, Ozone Park
•Kaganowich, Morton L., Binghamton
Kaiser, Harry M., New York
Ling, Suilin, New York
Moulton, Thomas S., New York
Mras, Raymond J., Corning
Mytchak, Peter, Olean
Sabatucci, Cesare, Olean
Svensson, Bertil A., New York
Vafiades, Nicholas V., Schenectady
Wolpson, Lawrence S., Richmond Hill

Ohio

•Davies, David K., Baberton
Fischer, Ralph C., Cleveland
Gardner, Ernest R., Salem
•Hunter, Wesley L., Newark
•Riley, Richard E., Massillon
•Wise, Richard T., Akron

Oklahoma

Davidson, Harvey E., Tulsa

●Studenmund, Robert R., Tulsa

Oregon

Lothgren, Cleve E., Corvallis

Pennsylvania

Baker, James D., Erie
Callowhill, Frederick R., Philadelphia
Cava, Frank J., Philadelphia
Clark, William T., Ridley Park
Fisher, John M., Latrobe
Fridrichsen, Anton F., Chadds Ford
Gale, Sydney L., Sharon
Knauss, G. Edwin, Gibsonia
Kopenhaver, William H., Martins Creek
●Kurlej, John S., Greensburg
Mayne, Anthony E., Meadville
Nalle, Richard T., Jr., Haverford
Prause, John J., York
Purcell, William J., Pittsburgh
Rafferty, John E., Yeadon
Rhein, Robert A., Pittsburgh
Rosecky, Rezbau J., Newton Square
Sherba, Paul S., Pittsburgh
Sibley, John R., Franklin
Webber, George H., Jr., Bridgeport
Weihsmann, Peter R., Ridgway

South Carolina

Steinegger, Ferdy R., Camden
Symes, Edward, Jr., Aiken

Tennessee

Gaines, Albert L., Chattanooga

Texas

Brill, Niles K., Baytown
Eichenberg, Robert, Houston
Hall, Harris H., Bellaire
Lubbock, Charles W., Baytown
Morgan, Thomas E., Houston
Pfeiffer, Charles V., Corpus Christi
Thompson, Herbert L., Houston
Watson, Robert M., Bellaire
Watts, John D., Houston

Vermont

●Renfrew, Clinton A., Northfield

Virginia

●Padis, Leo A., Blacksburg
●Royall, William L., Alexandria

West Virginia

Hudson, Thomas W., St. Albans
Mumma, Albert H., Charleston

Wisconsin

Bunch, Warren E., Milwaukee
●Medbery, Arnold B., La Crosse

Foreign

Acosta-A., Hernando, Bogota, Colombia
Britton, Robert V., Riverside, Ont., Canada
●Bryan, Bruce W., Antofagosta, Chile
●Eilon, Samuel, London, England
Feiner, Arthur, Alloa, Scotland
Gandhi, Om Parkash, Shapur, Serath, India
Horovitz, Markus W., Toronto, Ont., Canada
John, C. Kurien, Orissa State, India
●Liverant, Manfred J., Prescott, Ont., Canada
Medina, Armando, Caracas, Venezuela
Olmedo, Serafin G., Mexico, D. F., Mexico
Orkney, John C., Alloa, Scotland
Semin, Zdenek J., Durham, England

Transfers from Student Member to Associate Member, Class of 1956 10

Engineering Societies Personnel Service, Inc. (Agency)

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th St.	84 East Randolph St.	100 Farnsworth Ave.	57 Post St.

Men Available[1]

Chief Engineer or Engineering Manager, BS, MS, 42, 15 years' experience—research, design, development, product engineering on electronic and electromechanical equipment. ME-402.

Engineering Manager or Director of Engineering, BS Aero E, 43; 22 years aircraft engines, compressors, turbines, combustion, heat transfer, automatic machinery, packaging, atomic remote handling equipment; creative, aggressive supervisor with both technical and administrative abilities. Prefers New England or New York metropolitan area. ME-403.

Chief Engineer, BSME, 35; 15 years' handling and direction of engineering and manufacturing problems. Design and manufacturing-engineering experience in air-conditioning and related power fields. Prefers New York metropolitan area but will relocate. ME-404.

Chief Engineer or Director, MSME, 46; responsible background in design, development, research, and administration in fields covering appliances, plant equipment, heavy machinery, power plants, and personnel development. Skilled in new product development and product optimization for market potential particularly in appliances and metal-structural products. No preference as to location. ME-405.

Mechanical-Industrial Engineer, BSME, BA Chemistry, 35. Seeks responsible position utilizing engineering, administrative, and business knowledge. Excellent background in business administration, equipment design, engineering, writing, sales promotion in the paper, air-conditioning, and aircraft industries. Experience includes plant engineering, materials handling, research, production methods improvement, purchasing, and marketing problems. Location optional. ME-406.

[1] All men listed hold some form of ASME membership.

Positions Available

Chief Mechanical Engineer, mechanical graduate, at least eight years' design and product-engineering experience covering heavy gears, machinery, brakes, or allied power-transmission equipment. $8000–$12,000. Midwest. W-4400-(*a*).

Sales Engineer, mechanical graduate, sales experience covering diesel engines. Marine experience desirable. $6000–$9000. New York, N. Y. W-4648.

Teaching Personnel, mechanics, applied electricity, general physics. (*a*) Head of mechanics department, PhD in engineering preferred but will consider BS or MS. In addition to mechanics must be able to teach applied electricity (electrical machines and associated circuits). (*b*) Instructor to teach in the mechanics and physics department, MSME preferred but will consider a BS. Salary and rank dependent upon qualifications. Salary scale good. Room for advancement. West. W-4988.

Maintenance Engineer, mechanical-engineering training, plant engineering and maintenance experience covering construction and mining equipment, diesel and hydroelectric plant. Design work and machine-shop operation involved. Must speak Spanish. $6000–$7200. Colombia, South America. F-4998.

Manager of Manufacturing Engineering, 35–45, ME and process-industry experience such as rubber, plastics, etc., preferred, to direct industrial-engineering and process-engineering groups in 1200-employee plant of medium-sized company. To start, $12,000–$15,000, plus. N. J. W-5005.

Manager, Industrial Engineering, 30–45, degree in industrial or mechanical engineering, eight to ten years' manufacturing or industrial-engineering experience in the metalworking industries, preferably with metal fabricating and assembly manufacturer. Specific experience in field of machining, plating, press work, and assembly operations. Five years' experience as chief industrial engineer with responsibility for administration of industrial-engineering function of 500–2000–man operation. Salary open. Pa. W-5007.

Administrative Engineer, to administer programming and internal controls of the operation of the engineering division, co-ordinate application of company policies and programs, and supervise the drafting and checking functions for light metal-fabricating and assembly manufacturer. $10,000. Pa. W-5008.

Thermodynamicist, mechanical or chemical-engineering graduate, 30–35, advanced or highest degree from top-level school. Experience in process industries, mathematical analysis of engineering problems, thermodynamic theory, heat and mass transfer, design, construction, and testing of process equipment. Salary open. Western N. Y. W-5015.

Engineers. (*a*) Chief engineer, mechanical, for medium-sized company fabricating seamless steel and plastics. Will be in charge of tools, physical plant services, construction of special machinery, maintenance, and process engineering. $12,000–$15,000. (*b*) Junior engineer, graduate mechanical, three to five years' experience for an assistant to above-mentioned. $6000–$8000. Mass. W-5023.

Director of Engineering and Research, 35–45, mechanical-engineering graduate, at least ten years' administrative, research, and product-engineering experience, covering food and chemical-process machinery, controls, and materials-handling equipment. $12,000–$15,000, plus bonus. Midwest. W-5025.

Engineers. (*a*) Manager, applied mechanics subsection, BSME, BSEE, or BS Aero E., about ten years' experience to initiate, establish, and direct programs to solve problems in the specialized fields of mechanical-design configuration, heat-transfer, stress, vibration, fluid flow, and noise, including tests programs in connection with jet engines. (*b*) Manager, Materials Engineering, BSME or degree in metallurgy, about five years' experience as a supervisor, to manage a section responsible for development of new materials and for the materials and processing for existing engines. $13,000–$16,175. Midwest. W-5030.

Combustion-Development Supervisor, BSME, BSChE, or BSAE, with four years' experience in combustion research or development, working knowledge of test facilities and supervisory experience; will be responsible for initiating, establishing, and directing advanced analytical and experimental programs in augmentation combustion and thermodynamics. $10,600–$12,450. Midwest. W-5031.

Teaching Personnel for Mechanical-Engineering Department. (*a*) One for combination teaching and research, 12-month basis; MS degree with research experience or PhD. (*b*) One for full-time teaching, nine-month basis; MS or PhD. Teaching or research usually available during the summer. Rank and salary dependent on qualifications. South. W-5033.

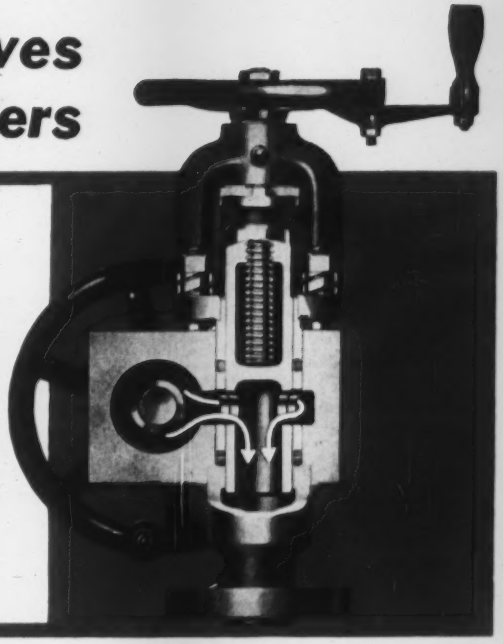
Teaching Personnel in Mechanical Engineering. (*a*) Associate and assistant professor in the areas of heat power, for both graduate and undergraduate instruction. (*b*) Instructor for undergraduate work. Small state university. Rocky Mountain area. W-5035.

Industrial Engineer, Staff, to make studies in production management; BSIE, CE, ME, five to ten years' experience making studies in production management including layout, cost control, quality control, maintenance, material handling, production planning; should be familiar with techniques of linear programming—

(*ASME News continued on page 714*)

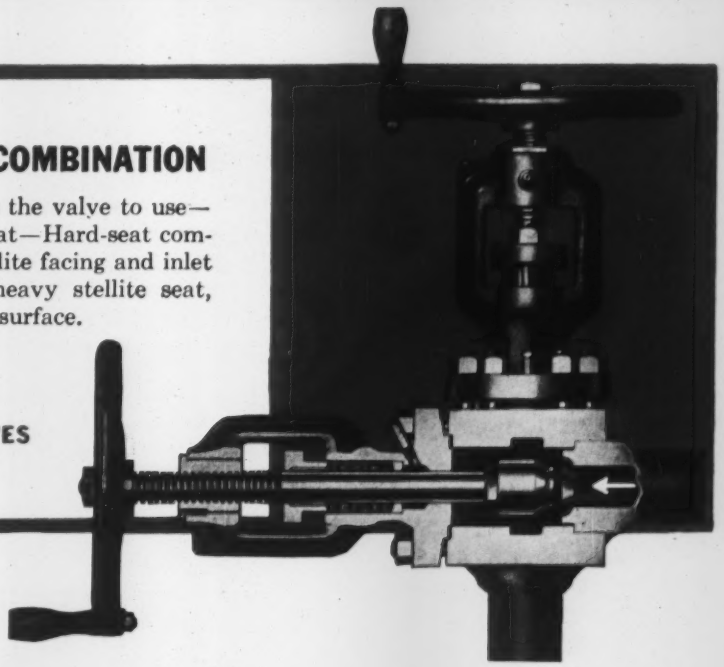
UNIT TANDEM

rugged blow-off valves for high pressure boilers



HARD-SEAT—SEATLESS COMBINATION

■ For boilers up to 1500 psi, this Yarway Unit Tandem Blow-Off Valve offers the maximum in dependable service. A one-piece forged steel block serves as the common body for the Yarway Stellite Hard-seat blowing valve and the Yarway Seatless sealing valve. All interconnecting flanges, bolts and gaskets are eliminated. The Unit Tandem at right is sectioned through Seatless Valve to show balanced sliding plunger in open position and free flow.



HARD-SEAT—HARD-SEAT COMBINATION

■ For boilers to 2500 psi, this is the valve to use—Yarway's Unit Tandem Hard-seat—Hard-seat combination. Disc has welded-in stellite facing and inlet nozzle has integral welded-in heavy stellite seat, providing smooth, hard-wearing surface.

OVER 4 OUT OF 5
HIGH PRESSURE PLANTS
USE YARWAY BLOW-OFF VALVES

Write for Yarway Catalog B-434

YARNALL-WARING COMPANY
108 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY **BLOW-OFF VALVES**

operations research—electronic data processing. To $9000. Western Pa. W-5036(a).

Designers. (a) Engineer to design and develop new types of office-duplicating equipment for line of duplicating products. Electromechanical experience helpful. (b) Process piping. Will provide staff services to laboratory groups in scale up of new products and processes. Experience in process-piping layout essential. Must be able to assume individual technical responsibility. (c) Machine Design. Will develop and design new processing and production equipment. Must be able to carry project from idea stage to installation. Experience in automatic or semi-automatic equipment helpful but not essential. $8000–$12,000 a year. Company pays placement fees. Midwest. W-5040.

Machine Designer, six to eight years of machine design, in field of metal processing machinery. Machine-tool design, packaging, and closure-machine experience considered likely background experience. Will study and evaluate methods of manufacturing with a view to actual development of new or improved types of production machines. Processes include blanking, roll forming, piercing, positioning, brazing, welding, soldering. $9000–$10,000. Upstate N. Y. W-5042.

Engineers. (a) Manufacturing Engineer, mechanical graduate, at least five years production and methods improvement covering electronic and electromechanical devices. (b) Standards supervisor, ME or IE, five to ten years' industrial-engineering experience, including MTM standards. $8000–$10,000. New York metropolitan area. W-5045.

Works Manager, at least ten years' production management, industrial engineering, and labor-relations experience covering machine shop, machinery, electromechanical devices, and electronic equipment. $20,000–$25,000. New York metropolitan area. W-5046.

Power Engineer, four years' minimum experience in steam and power generation, including boiler selection and operation up to 3500 psi, boiler controls for automatic operation, feed-water treatment, heat balance to determine thermal efficiency of boilers and power-generating equipment, pump selection and piping design, combustion of different fuels. Salary open. Ohio. W-5057-CD.

Engineers. (a) Market-research engineer, graduate, 28-32, to do product application and sales promotion and co-ordination. Considerable travel. (b) Plant liaison engineer, young, to coordinate application of products between plant and customer including materials and methods of manufacture. $6500–$7000. Western N. Y. State. W-5066.

Associate Professor of Engineering Administration, master's or PhD preferred. Should have a combination of industrial experience and some teaching experience. Opportunity for consulting research in this field. $6500–$8000. East Coast. W-5067.

Designers, mechanical, five to seven years' experience in mechanical product drafting including two to three years of product design. Engine-drafting experience desirable. Will prepare designs of medium, new and complicated jet engine components. Salaries open. Midwest. W-5071.

Engineers. (a) Senior process-equipment engineer, BSME, capable of supervising several design squads in chemical-process equipment components, know manufacturing and erection procedures. To $10,000. (b) Piping-design engineer, BSME, about ten years in chemical process—piping-design supervision, know manufacturing and erection procedures, pipe metallurgy, and competent to train and direct department of 50 people. (c) Senior engineer, to take charge API process piping. Experience as above-mentioned. *B* and *c*, $8000–$10,000. Pa. W-5080.

Project Managers and Senior Project Engineers, graduate mechanical or chemical engineers, to assume responsibility for major projects in low temperature or applied cryogenics. Should be able to finalize process and engineering flow sheets; prepare specifications for equipment piping and erection; supervise design, procurement, manufacture; and erection, test and final acceptance. To $12,000. Pa. W-5081.

Application Engineer, graduate mechanical, at least five years' experience in liquid-gas storage and handling systems, engineering, design, installation, customer contacts, for industrial gases. $10,000–$12,000. Pa. W-5082.

Engineers. (a) Manager of manufacturing, welding equipment, graduate mechanical, to 40. Operations include machine shop with auto-turret lathes, screw machines, drill presses and special equipment for mass production of small apparatus. Skillful in manufacturing methods and tooling for improving quality and reducing costs. To $12,000. (b) Manufacturing engineer, graduate mechanical, must know ASME code and stress analysis. Will set up and manage design section of manufacturing—control—methods and tool engineers; and manufacturing estimating groups. Must have at least ten years' experience in engineering as related to manufacturing, with heavy responsibility as planner and supervisor. $9000–$12,000. Pa. W-5083.

Wage Administrator, 32–40, college graduate, experienced in job evaluation with organized employees. Will administrate wage program in a large progressive manufacturing organization. Supervise job analysts, conduct area wage surveys, serve on appropriate corporation and community committees concerned with area of responsibilities. Potential for promotion to wage and salary administrator. $8000–$10,000. Upstate N. Y. W-5087.

Chief Draftsman, ten to 15 years' experience in automatic machine design. Will supervise ten engineers and set up complete standards. $8000–$9000. New York, N. Y. W-5090.

Sales Representative, sales experience covering fine-type heat exchangers for process industry. $9000–$12,000, plus bonus. New York, N. Y. W-5092.

Engineering Instruction, Instructor and Assistant Professor, for Mechanical-Engineering department to teach thermodynamics, mechanical-engineering lab. and/or heat-power courses. Salary, nine-month basis, depends on training, experience, and degrees. Southwest. C-6269.

Assistant Chief Engineer, mechanical, 32–50, five or more years' in heavy construction or drilling machinery. To do design of construction and mining equipment. Experience in diesel and gasoline power and heavy-transmission equipment. Good supervisory ability—to assume position of chief engineer in a year or less for a manufacturer. $12,000. Employer will pay placement fee. Ohio. C-6283.

Production Engineer—Instrument Manufacturer; BS preferred, 27–35, minimum of two to three years' experience in production planning, scheduling, and supervision manufacturing of laboratory equipment or similar articles for commercial, research, or school labs. $7200–$9600. Discuss placement fee with employer. San Francisco, East Bay. S-2910.

Mechanical Engineers, graduates: (a) Senior design engineer, five to ten years' experience design of mechanisms such as business machines to design small complicated mechanisms for economical manufacture. (b) Design engineer, three to five years' experience similar to aforementioned for mass production of stamped parts. (c) Designer; recent graduate interested in design or production of small mechanisms. (d) Research engineer, three to five years' experience with control switches relays, etc. Salary open. San Francisco East Bay. S-2903.

Power and Fuel Engineer—Steel Plant: Must be graduate ME or EE, minimum of ten years' experience in design and construction of facilities such as steam and water systems, fuel systems, all types of utility-distribution systems. To $12,000. San Francisco. S-2893.

Engineering Teachers-Mechanical; young, full-time appointments available as instructors or assistant professors to men under 30, PhD (or working toward PhD). Desirable half or three-quarter time appointments are open to men with some technical experience since BS who are qualified. Work on problems for which extra funds are available. Salary open. San Francisco Bay area. S-2887.

Conversion, Maintenance, and Design—Airframe, Air Structures, graduate aeronautical or mechanical. Recent graduate or up to three to four years' airframe experience. Deal with structures, land gear, control wheels, brakes, and aircraft interiors. Examine existing arrangements for proposed appropriate rearrangements. To provide for immediate relief or correction and recommend long-range construction corrections. Not a draftsman, but should be able to do board work or supervise draftsman, prepare specifications, and deal with other engineers or with representatives of aircraft manufacturers. Recent graduate, to $5700, three to four years' experience, $7200. Employer will pay placement fee. San Francisco. S-2876.

Obituaries

Harold Dale Barber (1891–1956), superintendent, Reserve Mining Co., Silver Bay, Minn., died Oct. 18, 1956. Born, Norwalk, Ohio, Dec. 31, 1891. Parents, Francis E. and Jennie Mae (Cain) Barber. Education, Yocum's Business School, Alexander Hamilton Institute. Married Ethel Loretta Boyle, 1915; children, Mary Elizabeth (Mrs. George Cervone), Francis Fagan, and James Richard Barber. Mem. ASME, 1948. Mr. Barber, a railroad specialist, had formerly been associated with the Erie Railroad as a vice-president.

Francis Eugene Blake (1875–1956), senior draftsman, Watervliet Arsenal, Watervliet, N. Y., died Nov. 13, 1956. Born, Dodge Center, Minn., March 15, 1875. Education, BS(ME), Sibley College, Cornell University, 1899. Assoc-Mem. ASME, 1901.

Moro Miller Borden (1877–1956), consultant, Simplex Valve & Meter Co., Lancaster, N. J., died Nov. 17, 1956. Born, Philadelphia, Pa., June 16, 1877. Parents, William Summerill and Ella (Kennard) Borden. Education, attended evening courses at Drexel Institute and The Franklin Institute. Married Linda Fleming Smith, 1906; two sons, Edward William and Kennard Fleming. Mem. ASME, 1913. Mr. Borden was a member of the first ASME Fluid Meters Committee. He was an active member in The Franklin Institute and the American Water Works Association. He held many patents.

Charles Rounds Chisholm (1883–1957), retired shipbuilding engineer, Kennebunkport, Me., died April 1, 1957. Born, Kennebunk, Me., March 29, 1883. Parents, Kingman N. Chisholm and Miriam (Rounds). Education, attended evening courses at The Johns Hopkins University. Married Mary A. O'Neill, 1915. From 1905 to 1922 he worked in various capacities on the Panama Canal; the last four years as chief planner to the Mechanical Division of the Canal. Later, he was superintendent engineer in London, England, for three years, with the United States Shipping Board. Mem. ASME, 1934. Mr. Chisholm served as chairman of the Baltimore Section, ASME, 1938–1939. He was a registered engineer in the State of Maryland.

William Cockram (1891–1957), president, W. Cockram & Co., Ltd., Paris, Ont., Canada, died March 14, 1957. Born, Stafford, England, March 25, 1891. Parents, Samuel Thomas and Mary Ann (Eccleston) Cockram. Education, public schools in England and private tuition. Married Alice Redfern Knight, 1915 (died 1956). Mem. ASME, 1940. He is survived by his four children: Mrs. Charles Karn, Woodstock, Ont.; Mrs. W. W. Beatson, Peter R. Cockram, both of Toronto; and Mrs. R. E. Hosack, Paris, Ont.

Charles Bannister Cook (1875–1955), vice-president, Royal Typewriter Co., New Hartford, Conn., died Dec. 13, 1955. Born, Lydenham, England, Oct. 14, 1875. Parents, William B. and Sarah (Sewell) Cook. Education, correspondence schools, Albany Business College, hon. MA, Trinity College, 1936. Naturalized U. S. citizen, Hartford, Conn., 1906. Married Eliza J. Johnston, 1900; three children, Dorothy L., Charles B., Jr., and Alan Sewell Cook. Assoc-Mem. ASME, 1913. Mr. Cook has published articles in several trade journals and held patents on office equipment.

Reimier Pyl De Vries (1886–1956), consulting engineer, Wilton, N. H., died Oct. 17, 1956. Born, Rotterdam, Holland, Jan. 30, 1886. Parents, Jan and Stevetiana (Valkenburg) De Vries. Education, attended Engineering Training School and Technical Academy, Rotterdam, Holland; and studied at Columbia University and the Boston Technological Institute. Mr. De Vries became a naturalized U. S. citizen. Married Mary Vielvoye, 1911. He is survived by his widow. Assoc-Mem. ASME, 1917; Mem. ASME, 1935.

Otto Haentjens (1879–1957), president, Barrett, Haentjens & Co., Hazleton, Pa., died March 30, 1957. Born, Mulheim am-Rhein, Germany, Oct. 24, 1879. Parents, Carl Peter and Emma Wilhelimine (Siller) Haentjens. Education, Konishnish Technische Hochschule, Charlottenberg, Germany. Mr. Haentjens became a naturalized U. S. citizen. He held many patents. His opposed impeller two-stage pump design is now standard equipment throughout the world. Mem. ASME, 1931. He was a member also of the American Institute of Electrical Engineers, and the American Institute of Mining and Metallurgical Engineers. His wife, Grete, died in 1951. He is survived by his children, Richard Peter, Phoenix, Ariz., and Walter Dietrich Haentjens.

Charles Howard Hoskins (1914–1956), design-development engineer, De Laval Steam Turbine Co., Trenton, N. J., died July 3, 1956. Born, Trenton, N. J., Oct. 3, 1914. Parents, Walter and Sara Hoskins. Education, attended Rensselaer Polytechnic Institute, 2 yr.; night courses, Rut-

(ASME News continued on page 716)

SYSTEMS 1

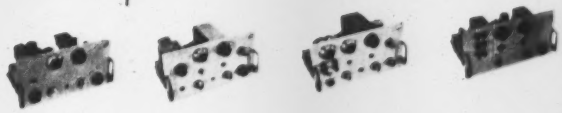
BASIC "150" assemblies housed in either vertical mobile cabinets or separate portable cases are available in 1-, 2-, 4-, 6- and 8-channel models. Each is equipped with driver amplifiers of current feedback design and regulated power supplies for *each* channel, and a recorder featuring *nine* extremely accurate paper speeds on 2- to 8-channel models, five on single channel units. Appropriate plug-in preamplifiers quickly and efficiently equip a basic assembly for recording virtually any 0-100 cps phenomena.

new 6- and 8-channel analog readout systems

In addition, complete Sanborn systems from 2- to 8-channels are available for recording analog computer outputs. These are equipped with dual-channel DC amplifiers, for single-ended or push-pull signals — input impedance 5 megohms each input lead to ground — drift less than 0.5 mm/hr. — frequency response down 2 db at 60 cycles for all amplitudes to 4 cm peak to peak. Newest of the computer readout recorders are the 6- and 8-channel console systems (8-channel illustrated — "A" at left). The Model 183 Programmer in a Model 184 case ("B" at left) is optional for use with the 6- and 8-channel consoles. The Programmer automatically turns on chart drive, feeds calibrated signals to all channels, reads computer DC levels, determines the length of record, and shuts off the paper drive.

SANBORN

oscillographic recording equipment



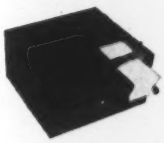
2 PREAMPLIFIERS

A choice of *twelve* "150 Series" plug-in preamplifiers is now available, to equip systems for any of numerous recording problems. Improved control of input signals results from attenuator ratios of 1, 2, 5, etc., and calibrated zero suppression on AC-DC, Carrier, and Low Level DC Coupling, Frequency Meter, and Chopper Stabilized DC models. Other "150" preamplifiers include: Servo Monitor, Log-Audio, AC Wattmeter, RMS Volt/Ammeter, 400 cycle Frequency Deviation, and Triplexer.

Added to these three aspects of Sanborn Oscillographic Recording Equipment are the basic advantages of inkless recording in true rectangular coordinates, to provide accurate, easily interpreted records; high torque galvanometer (10 ma develops 200,000 dyne cm.); one percent linearity resulting from current feedback driver amplifiers and high torque galvanometers (maximum error is ¼ mm in middle 4 cm of chart, ½ mm across entire chart); controls for timing, manual and remote coding.

Take advantage of the scope and flexibility of Sanborn equipment to answer your recording requirements. Sanborn engineers will be glad to provide further information and application assistance whenever you wish. Contact your local representative or write to the main office below.

3 UNIT INSTRUMENTS



All Sanborn Preamplifiers and Recorders, as well as various other units, are available separately for specialized applications or use as "original equipment" in other apparatus. Instruments include the Model 150-300/700 Wide Band Driver Amplifier and Power Supply, for use with low power galvanometer elements, a 'scope and/or panel meter. When equipped with suitable "150" preamplifier, this amplifier provides a portable indicator for strain, force, pressure, temperature, AC watts, audio level, etc. Other units include the Model 150-1900 Master Oscillator Power Amplifier; Model 150-3100 Triplexer; Model 601 and 602 galvanometers; Model 150-2900 Dual-Channel DC Amplifier.

SANBORN COMPANY
INDUSTRIAL DIVISION
175 WYMAN ST. WALTHAM 54, MASS.

gers University. Married Lorraine Bechtloff, 1951; children, Michelle Linda and Kathy Ann Hoskins. Jun. Mem. ASME, 1943.

John Thomas Kelly (1905–1957), engineer, Design Division, E. I. du Pont de Nemours & Co., Inc., Newark, Del., died March 26, 1957. Born, Pittston, Pa., May 29, 1905. Education, BS (ME), Clarkson College of Technology, 1929; MS, 1930. He was employed by the University of Chicago as an engineer to co-ordinate the design and construction work on the AEC Argonne National Laboratory at Lemont, Ill. Mem. ASME, 1949.

Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

Please Print

ASME Master-File Information

Date

LAST NAME FIRST NAME MIDDLE NAME

POSITION TITLE NATURE OF WORK DONE
e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give name in full) Division, if any

*☐

EMPLOYER'S ADDRESS City Zone tate

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER, e.g. Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

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HOME ADDRESS City Zone State

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Address changes effective when received prior to:

☐ Mechanical Engineering	10th of preceding month
☐ Transactions of the ASME	20th of preceding month
☐ *Journal of Applied Mechanics*	20th of preceding month
☐ *Applied Mechanics Reviews*	1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

☐ A—Aviation	☐ J—Metals Engineering	☐ S—Power
☐ B—Applied Mechanics	☐ K—Heat Transfer	☐ T—Textile
☐ C—Management	☐ L—Process Industries	☐ U—Maintenance and Plant Engineering
☐ D—Materials Handling	☐ M—Production Engineering	☐ V—Gas Turbine Power
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ W—Wood Industries
☐ F—Fuels	☐ O—Lubrication	☐ Y—Rubber and Plastics
☐ G—Safety	☐ P—Petroleum	☐ Z—Instruments and Regulators
☐ H—Hydraulics	☐ Q—Nuclear Engineering	
	☐ R—Railroad	

William Arthur Kennedy (1883–1957), supervisor of products, Grinnell Corp., Providence, R. I., died April 8, 1957. Born, Providence, R. I., Aug. 13, 1883. Parents, William Henry and Harriet E. (Burt) Kennedy. Education, PhB, Brown University, 1906; ScB(ME), 1907. Assoc. Mem. ASME, 1908; Mem. ASME, 1914. Mr. Kennedy had been active on various ASME committees in his local section. He was a past president and secretary of the Providence Engineering Society. He held several patents on sprinklers and sprinkler alarm equipment.

John Elmer Matthews (1928–1957), guided missile test engineer, Convair-Astronautics Division, General Dynamics Corp., Patrick Air Force Base, Titusville, Fla., died March 7, 1957. Born, Cambridge Springs, Pa., Sept. 12, 1928. Education, BS(ME), Case Institute of Technology, 1951. Assoc. Mem. ASME, 1952.

Philip Arthur Potter (1878–1957?), whose death recently was made known to the Society, was a water engineer, New Jersey Board of Public Utility Commissioners, Newark, N. J. Born, Palmer, Mass., Jan. 18, 1878. Parents, Philip Henry and Clara M. (Murdock) Potter. Education, SB, Massachusetts Institute of Technology, 1901. Married Melania Helen Kunst, 1912; children, Philip Arthur, Jr., Wanda Lorane, and Dorothy Helen Potter. Mr. Potter held more than 200 patents pertaining to water meters and their protection against corrosion by the use of vitreous enamel, and was the author of a paper presented before the American Water Works Association. Mem. ASME, 1937.

Redfield Proctor (1879–1957), president, Vermont Marble Co., Proctor, Vt., and Governor of the State of Vermont, 1923–1925, died Feb. 5, 1957. Born, Proctor, Vt., April 13, 1879. Parents, Redfield and Emily J. (Dutton) Proctor. Education, BS, Massachusetts Institute of Technology, 1902; hon. MS and LLD, University of Vermont; hon. LLD, Middlebury College and Norwich University. Married Mary S. Hedrick, 1905; children, Margaret Proctor Floe, Robert Dutton, and Katharine Proctor. Jun. Mem. ASME, 1905; Assoc. Mem. ASME, 1906. In 1929 and 1930, Mr. Proctor was president of the New England Council. He was director of the United States Chamber of Commerce. During World War I, he served as captain of engineers in the U. S. Army, and from 1924 to 1934 he was colonel and commanding officer of an engineers reserve unit. He was a member also of the National Geographic Society, the American Museum of Natural History, the American Forestry Association, and the National Aeronautics Association.

Joseph George Prosser (1865–1957?), whose death was recently reported to the Society, was a retired mechanical engineer. He made several improvements of more or less importance in textile and power plant machinery. Born, Limerick, Ireland, Nov. 28, 1865. Parents, Thomas and Eunice (Hopkins) Prosser. Education, certificates extending over entire course of six years, Bristol University College, Bristol, England. Married Lois Pope, 1891; children, Thomas, Ruth, Katherine. Assoc. Mem. ASME, 1891; Mem. ASME, 1898. Mr. Prosser was the donor of the Joseph G. Prosser Library, Western Personnel Institute, Pasadena, Calif.

Ellwood Franklin Riesing (1907–1957), sales engineer, Inland Manufacturing Division, General Motors Corp., Dayton, Ohio, died March 30, 1957. Born, Milwaukee, Wis., Nov. 1, 1907. Education, BA, University of Wisconsin, 1928. Mem. ASME, 1942. In 1930–1931, while he was in the employ of the Chain Belt Co., he was in charge of design and installation of conveying equipment sold to the Russian Government for their tractor plants. This job required his supervision for over 13 months in Russia. He spent the following eight months in Western Europe appraising special engineering problems. Mr. Riesing, a specialist in vibration isolation by means of rubber, held eight patents in that field. He was a member also of the Society of Automotive Engineers, The Engineering Society of Detroit, and the Detroit Rubber and Plastic Group, Inc.

Frank Calvin Spencer (1880–1956), production engineer, Maplewood, N. J., died Aug. 16, 1956. Born, Cambridge, Mass., April 18, 1880. Parents George W. and Ann (Nelson) Spencer. Education, attended Cambridge Manual Training School and Columbian College, George Washington University. Married Helen W. Erwin, 1911. Assoc. Mem. ASME, 1908; Mem. ASME, 1912. Mr. Spencer was active on ASME committees. He was chairman of the Cutting of Metals Committee, 1932–1933; and of the Machine Shop Practice Division, 1931–1932. He served on the Committee on Admissions, 1934–1939. He is survived by his widow and a son, Frank C. Spencer, Jr.

James Alfred White (1873–1956), consultant, Lockport, N. Y., died Nov. 5, 1956. Born, March 2, 1873, Buffalo, N. Y. Jun. ASME, 1900; Assoc. Mem. ASME, 1918. At one time Mr. White was chief engineer of the Harrison Radiator Corp., Lockport, N. Y.

WHAT'S SPECIAL ABOUT LJUNGSTROM®

structural details?

. . . many things.

And all make air preheating with a Ljungstrom more economical, less troublesome. The Ljungstrom offers these refinements:

- The welded steel rotor is strong enough to support the heating elements without strain, yet flexible enough to withstand extreme temperature variations.
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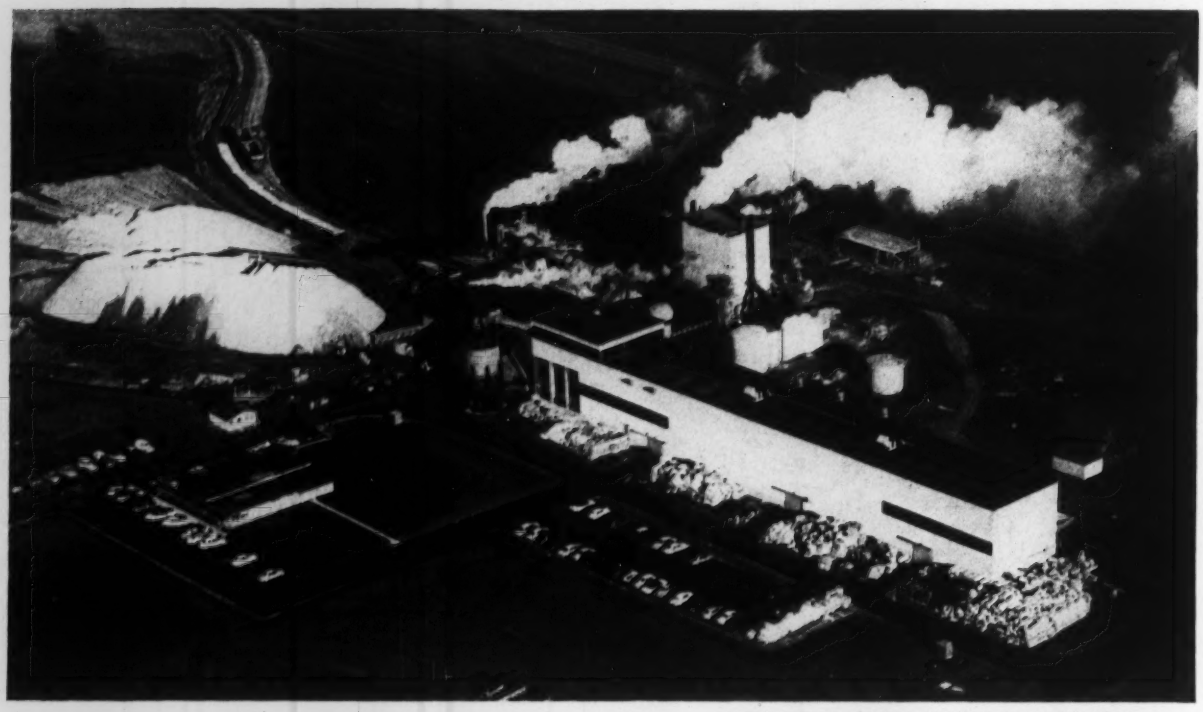
- A mass flow soot blower is installed as original equipment at the cold end where deposits are most apt to accumulate.
- The hot end heating surface is made from open-hearth steel sheet and the cold end from heavier gauge, low-alloy corrosion-resisting material because corrosion is normally confined to the cold end.

The Air Preheater Corp. is constantly working to improve Ljungstrom heating surfaces, seals, bearings, and other structural details. And, in general, these improvements can be applied to existing units with only minor changes and at nominal cost. Another reason why seven out of ten air preheating installations are Ljungstrom. For the full story on how the Ljungstrom design and construction can cut your fuel costs, increase plant efficiency, write for our 38-page manual.

The Air Preheater Corporation, 60 EAST 42ND STREET, NEW YORK 17, N. Y.

At this new Western Kraft plant...



Consulting Engineers and Architects: SANDWELL & COMPANY, Vancouver, B. C.
General Contractor: HOFFMAN CONSTRUCTION CO., Portland, Ore.
Mechanical Contractor: HOFFMAN ENGINEERING CO., Portland, Ore.
Plumbing Contractor: VERN COLLINS PLUMBING CO., Salem, Ore.

—as in the selection of a plant site,
efficiency determined the choice of

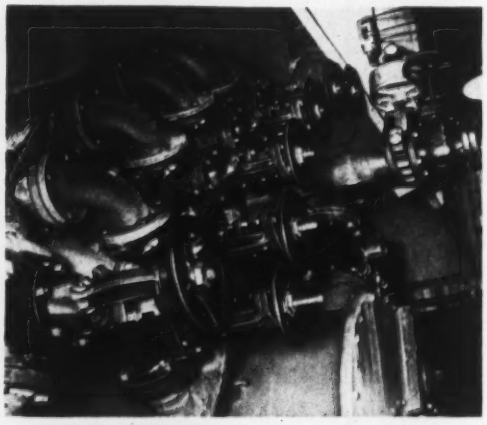
JENKINS VALVES

It hits you even before your tour through the new Western Kraft Corporation plant begins. *Efficiency*. From forest to finished product, here is efficient operation in the manufacture of high-quality kraft paper.

The plant site — a 100-acre tract near Albany, Oregon — was selected primarily because of its central location in relation to the supply of wood chips from the surrounding timber areas.

All operating equipment was chosen with the same foresight, on the basis of proved ability to do its job to perfection. When it came to valves for controlling processing and other piping, an experienced management, architects, engineers and contractors quickly wrote the specification . . . "JENKINS"

No other valves have such a long record of efficient, economical performance. The Jenkins Diamond on a valve has been a mark of extra value, trusted by building experts and plant operating men for nearly a century. Valves that bear this famous mark cost no more. Jenkins Bros., 100 Park Ave., New York 17.



Manifold of Jenkins Nickel Iron Gate Valves on the liquor washers controlling the showers.

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
SINCE 1864
Jenkins Bros.

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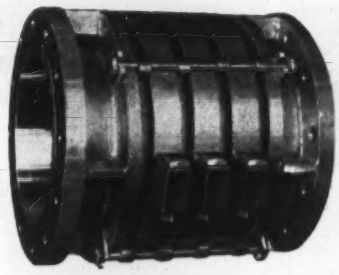
NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Available literature or information may be secured by writing direct to the manufacturer. Please mention MECHANICAL ENGINEERING.

NEW EQUIPMENT



Expansion Joints

A line of improved corrugated self equalizing expansion joints for power and process piping systems is available from Zallea Brothers, 815 Locust St., Wilmington, Del.

In protecting piping and related equipment against damage due to temperature change, the new expansion joints employ equalizing rings to distribute pipe line expansion equally to all of the corrugations. This prevents over-compression of the corrugations beyond their design limit, the firm states.

The equalizing rings also support the roots of the corrugations against internal pressure. The company says this permits the use of thinner metal in the bellows, giving the self equalizing expansion joints lower flexing stresses and thus longer operating life.

According to the company, the expansion joints feature four major improvements over previous models. They are: 100 per cent longer life, 30 per cent length reduction, 30 per cent less weight, and greater stability at high pressures because of the reduction in ratio of length to diameter.

Made from stainless steel, the expansion joints are available in sizes from 3-in. diam to 72-in. diam in single or double units. They are used for pressures up to 300 psig and temperatures up to 1600 F. Copper self equalizing expansion joints for use with copper and brass piping are available from 3-in. to 24-in. diam in both single and double units. Maximum operating pressures for copper expansion joints is 125 psig and 406 F.

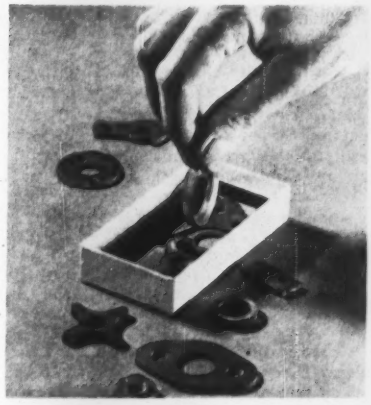
Miniaturized Motorpump

Vickers Inc., Detroit 32, Mich., announces a new line of miniaturized motorpumps.

Model AA-19054 delivers 0.84 gpm at 7400 rpm and 1000 psi; the hydraulic pump weighs 1.0 lb and the electric motor 7.0 lb. Overall length of both the pump and motor is $9^{15}/_{16}$ in.

Although life characteristics are in keeping with missile application, the miniaturized version retains the same overall efficiency as the firm's axial piston pump design for comparable displacements, the company states. Starting torque is less than 10 per cent over maximum running torque. The high pump efficiency and low starting torque permit use of a smaller, lighter electric motor, the firm reports.

The electric motor for the motorpump is a 28 v d-c unit rated at 0.84 hp. It is equipped with a radio noise filter and is explosion-proof.



Small Precision Castings

A kit of castings and sintered metal parts is being offered free by the Sparta Foundry Div., Muskegon Piston Ring Co., Sparta, Mich.

The kit is designed, according to the company, to show the techniques, control and know-how utilized in developing a variety of products. Parts included are those which have been designed and processed to eliminate or substantially reduce finishing and machining operations.

Samples show casting holes, recesses and projections and how parts have been surface ground and finish machined to meet specifications.

Oil and Gas Power Exhibit

Thirty manufacturers exhibited processes, products and equipment of interest to engineers at the 29th annual Conference and Exhibit of the Oil and Gas Power Division, ASME, May 20–23 at Louisville, Ky. Here's what members who attended the exhibit saw:

Aluminum Co. of America, 1501 Alcoa Bldg., Pittsburgh, Pa., showed diesel engine forgings and castings and aluminum bearings.

American Air Filter Co., Inc., 215 Central Ave., Louisville, Ky., displayed its multi-duty air filter, Roll-O-Matic air filter, type W Cycoil intake air filter and a new horizontal gas cleaner.

American Bosch Arma Corp., American Bosch Div., Springfield, Mass., featured automotive electrical products and diesel fuel injection equipment.

C. Lee Cook Co., Div., Dover Corp., 916 S. 8th St., Louisville, Ky., displayed metallic packing, industrial piston rings, hydraulic rings, alloy rings for atomic energy, special aircraft oil seals, valve plates.

Burgess-Manning Co., Libertyville, Ill., showed noise control equipment as applied to internal combustion engines, blowers, compressors.

Cleveland Graphite Bronze Co., Div., Clevite Corp., 17000 St. Clair Ave., Cleveland 10, Ohio displayed bearings, bushings, thrust washers, seals and allied products.

Commercial Filters Corp., Melrose, Mass., featured its Fulflo filters and replaceable honeycomb filter tubes and Flo-Pac pleated paper elements and by-pass filters for fuels and lubricating oils.

Daros American Corp., 8128 N. Lawndale Ave., Skokie, Ill., displayed a line of piston rings.

Diamond Chain Co., Inc., 402 Kentucky Ave., Indianapolis 7, Ind., showed roller chains and sprockets for engine timing, auxiliary drives and flexible couplings.

Engineering Controls, Inc., affiliate of St. Louis Shipbuilding & Steel Co., Paul Brown Bldg., St. Louis, Mo., presented a schematic outline of its vapor phase systems and a model of M/V Lachlian MacLeay.

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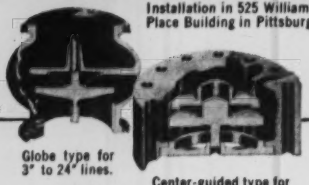
SURGE-PRESSURE
DAMAGE
In Air Conditioning Systems

Installation in 525 William Penn Place Building in Pittsburgh.



Globe type for 3" to 24" lines.

Center-guided type for 1" to 10" lines.

WILLIAMS-HAGER
FLANGED
Silent
CHECK VALVES

Surge pressures . . . and resulting water hammer . . . are effectively controlled by these valves. They close instantly whenever flow reversal starts, or when flow is zero—providing dependable protection for piping, pumps and other components in air conditioning systems.

Write for Bulletins:
No. 654 on the Valves
No. 851 on Cause, Effect and Control of Water Hammer

THE WILLIAMS GAUGE CO., INC.
149 Stanwix Street
2 Gateway Center Pittsburgh 22, Pa.
Our 71st Year • 1886-1957

Oil and Gas Power Exhibit

Begins on page 39

Fairbanks Morse & Co., 600 S. Michigan Ave., Chicago 5, Ill., showed an animated model of its opposed piston diesel engine.

Hilliard Corp., Elmira, N. Y., displayed industrial oil filters and clutches.

Illinois Testing Laboratories, Inc., 420 N. LaSalle St., Chicago 10, Ill., featured Alnor temperature measuring and controlling instruments.

International Nickel Co., Inc., 67 Wall St., New York 5, N. Y., built its display around nickel alloyed materials.

Johnson Bronze Co., S. Mill St., New Castle, Pa., showed sleeve type bearings, bushings and parts.

Kistler Instrument Corp., 15 Webster St., North Tonawanda, N. Y., displayed SLM engine pressure indicators for engineering test, production test, troubleshooting and performance evaluation of diesel, gas and gasoline engines.

Koppers Co., Inc., Metal Products Div., 200 Scott St., Baltimore, Md., presented couplings, mechanical shaft seals, piston rings, industrial sound control equipment, industrial cooling fans.

Massey & Marquette Governor Div., Curtiss-Wright Corp., Watertown, N. Y., featured engine governors.

Miehle-Dexter Supercharger Div., Christensen Machine Co., 100 Fourth St., Racine, Wis., displayed turbo chargers, superchargers and blowers.

Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, showed its LO908 engine thermostat, pneumatic operated radiator shutter, C437 gas pressure switch, engine safety controller, explosion-proof pressure switch, pressure controller, diesel pyrometer and thermocouple and wire.

D. Napier & Son Ltd., Action, London, England, displayed models of its Deltic diesel, turbochargers and gas turbines.

Nordberg Mfg. Co., 3073 S. Chase Ave., Milwaukee 1, Wis., showed diesel, gas and Duafuel engine generator sets, pumping and compressor drive engines, diesel marine engines, cone crushers, primary gyratory crushers, grizzlies and screens, grinding mills, kilns and other ore processing equipment, mine hoists, railway track maintenance machinery.

Wm. W. Nugent & Co., Inc., 3440 Cleveland St., Skokie, Ill., featured oil filters and strainers and lubricating devices

Scintilla Div., Bendix Aviation Corp., Sidney, N. Y., displayed diesel engine fuel injection equipment and ignition systems designed for the petroleum industry.

Shell Oil Co., 50 W. 50th St., New York 20, presented lubricating oils and marine lubricants.

Socony Mobil Oil Co., Inc., 150 E. 42nd St., New York 17, N. Y., featured petroleum products for industry.

Speed Scientific School, University of Louisville, Louisville, Ky., displayed miscellaneous equipment of interest to marine and pipeline, oil and gas power engineers.

Van der Horst Corp. of America, 1645 E. State Rd., Olean, N. Y., showed Porous-Krome plated diesel power cylinders.

Wilkening Mfg. Co., 2000 S. 71st St., Philadelphia 42, Pa., featured Pendrick engineered sets of new type Formflex conformable piston rings for diesel, natural gas, kerosene, distillate and gasoline engines.

Woodward Governor Co., Rockford, Ill., displayed precision speed governors.

Pipe Vise

A pipe and conduit vise, designed for hard use and featuring a number of design improvements, has been announced by Toledo Pipe Threading Machine Co., Toledo 4, Ohio.

The No. 22 vise is built with a large diameter acme screw thread connected directly to the upper jaw. According to the company, the vise yoke mounts quickly for right or left hand use. Hardened steel, interchangeable jaws are designed for maximum grip regardless of pipe or conduit size. A large bolting area is said to assure secure attachment of vise to bench and the contact points are evenly distributed.

Jack Belt Conveyor

Non-stop production and automatic coordination of a vibrating bag packer with a sewing machine are said to be provided by a jack belt conveyor developed by Richardson Scale Co., Van Houten Ave., Clifton, N. J.

The conveyor is located beneath an automatic scale with the sewing machine conveyor position in line with it. In operation, a bag resting on the conveyor is attached to the discharge spout of the scale. When the bag is filled, the operator steps on a foot pedal to start the vibrating action of the packer.

At the completion of the packing, the operator releases the pedal. The packer stops and the jack belt starts up. The bag travels to the sewing machine conveyor and on to the sewing machine station.

The new conveyor has a center distance of $3\frac{1}{2}$ ft between the pulleys, permitting close placement of sewing machine to scale. Belt speed is 75 ft per min. Components for the new conveyor include motor and brake, as well as V-belt drive to a shaft-mounted gear-reducer. Pulleys are the self-cleaning cage type.

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NEW EQUIPMENT
BUSINESS NOTES
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Electronic Read-out Tube

A miniature, all-electronic device called the Nixie, which converts electronic signals directly to readable characters, has been announced by Electronic Tube Div., Burroughs Corp., Plainfield, N. J.

The miniature unit is a gas-filled, cold cathode, 10-digit numerical indicator tube having a common anode. It is intended for use as a direct, in-line, read-out device.

Four times smaller than the standard Nixie, the miniature is $^{6}/_{10}$ in. in diam, $^{3}/_{4}$ in. high, and clearly visible at 10 ft, the manufacturer states. The miniature tube utilizes 100 v (approximately 40 per cent less voltage than the standard size) and operates at $^{1}/_{8}$ w ($^{1}/_{3}$ less wattage), it is claimed.

It has a simple plug-in stem, perfectly formed figures precisely aligned, and controllable brilliance, the company says, and it is not affected by environmental conditions.

Designed for miniaturized instrumentation, the miniature unit is claimed to have applications wherever read-out is required, including aircraft instrument panels, computers, industrial control, counters, military electronic indicators, digital voltmeters, fluid meters, elevators, channel indicators.

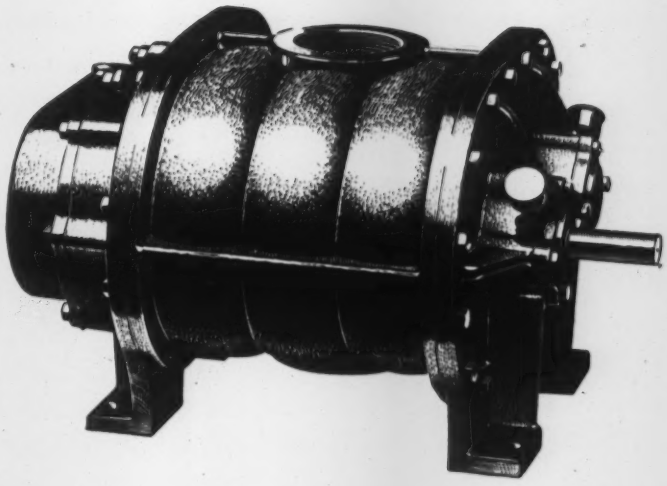
The miniature Nixie is capable of being operated with the firm's beam switching tube, a mechanical switch or any suitable voltage source.

Push Button Switch

A new dust and vibration-proof, push-button industrial switch with a rating of 6 amp T, 125 v, 3 amp, 250 v has been developed and is being marketed by McGill Mfg. Co., Inc., Valparaiso, Ind.

Standard with 6-in. wire leads, the new 25-P switch also can be ordered with soldering lugs or screw terminals. According to the company, damage from vibration or dust is impossible because of a molded phenolic case. The push button is $^{3}/_{8}$ in. in diam and finished in nickel.

Other models of the new industrial switch are the 27-P, a 3-way type of 6 amp, 125 v rating, and the 28-P, a two-circuit type for controlling either of two circuits. It has no off position and is rated at 6 amp, 125 v.



R-C rotary positive blowers deliver clean air in large or small volumes

Whether you require 5 or 100,000 cfm of accurately controlled volumes of air, Roots-Connersville rotary positive blowers assure performance that meets the most exacting specifications.

- No internal lubrication . . . air is free of oil vapors or moisture.
- High volumetric efficiency maintained with negligible slippage and with constant volumes delivered regardless of pressure.
- Impellers make no internal contact keeping friction loss small.
- Higher operating speeds result in reduced first cost, less weight and floor space. Horsepower is determined by operating pressure, resulting in maximum power savings.
- Drives may be direct-connected to electric motors, turbines, steam or gas engines . . . or speed reducing gears or V-belts.

In chemical, waste treatment, refining, paper and many other industries, R-C blowers have earned outstanding acceptance. R-C application engineers will welcome the opportunity to help solve your problem, large or small. Write for Bulletins AF-154 on small blowers or RB-154 on large units.

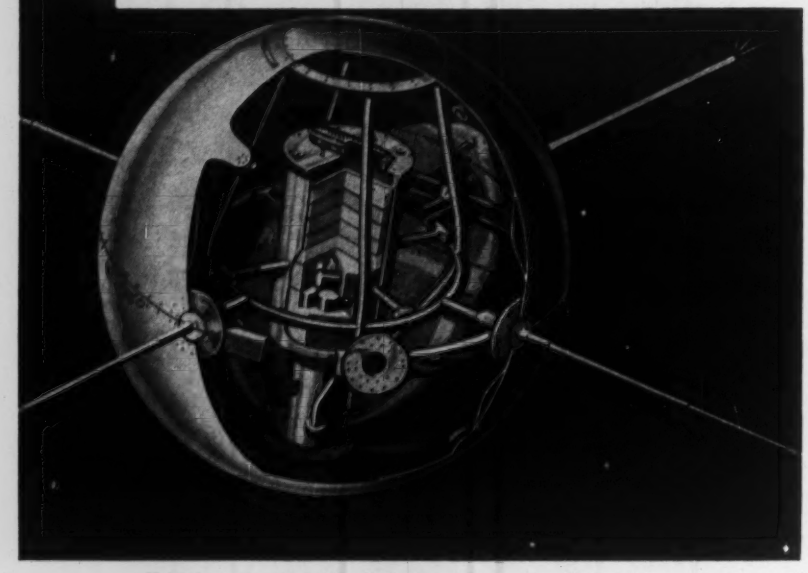
Engineers—unusual career opportunities await you at Roots-Connersville. Address your resume to Professional Employment Manager.

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.

757 Michigan Avenue, Connersville, Indiana. In Canada—629 Adelaide St., W., Toronto, Ont.

ENGINEERS: *Electronic & Mechanical,* **PHYSICISTS**



Melpar's work on the earth satellite is one of many diversified projects.

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At Melpar the problems posed by our more than 90 current projects allow you to work in the area of your choice and make contributions on advanced levels.

Our dynamic growth (we've doubled in size every 24 months for the past 11 years) constantly creates new middle and top level openings; our policy of *individual recognition* allows you to compete for them *strictly* on merit, and to receive financial compensation limited only by your ability.

As a member of a Melpar project group you'll enjoy freedom and a team spirit found only in a young organization of our size. Each project group is charged with responsibility for solving problems from conception to prototype. This means that you gain invaluable experience in inter-related spheres, essential to eventual directorship responsibility.

Living is relaxed and good in the Washington, D. C. area with its mellow climate and spacious suburbs. Our new air-conditioned laboratory is well-instrumented with an eye to future needs and is situated on a wooded 44-acre tract.

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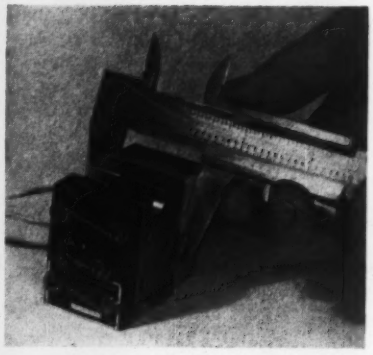


Torque Motor

The new Model 11 torque motor developed by Midwestern Instruments, Tulsa, Okla., now is in quantity production, the company reports.

Designed as a powerful actuator primarily to stroke the flow-controlling element in hydraulic or pneumatic servovalves, the motor is now being utilized in engineering fields as a basic transducer to convert a few watts of input power into a linear mechanical motion with forces up to 7.5 lb, the company says.

The motor features completely impregnated and incapsulated coils to allow it to be used in high humidities or immersed in hydraulic fluids. It weighs 14 oz, and the unit will operate at relatively high ambient temperatures (up to 300 F) with frequency responses up to 300 cycles per second.

Teflon Molding Process

A patent for a new process for molding Teflon tetrafluoroethylene resin into articles of thin cross section, $^1/_{16}$ in. or less, has been granted to Sparta Mfg. Co., Dover, Ohio, Div. U. S. Ceramic Tile Co.

According to the company, the new process has already been applied to manufacture articles to Teflon as thin as 0.006 in. in rapid, economical production and with close tolerances, uniform and free of cracks, and with little or no material waste.

Industrial Television

Allen B. Du Mont Laboratories, Inc., 750 Bloomfield Ave., Clifton, N. J., announces a line of industrial television equipment designed to satisfy the demands of every application from the least expensive to the most elaborate.

Focal points of the flexible ITV product line are two models of videcon camera equipment in two price ranges. According to the firm, completely installed ITV systems utilizing the self-contained TC-100 camera are available at about $2000. The cost of an installed system incorporating the deluxe TC-200 camera equipment, featuring a 3-lb unit measuring only 3 in. wide, $3^1/_2$ in. high, 10 in. long, is approximately $3500.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

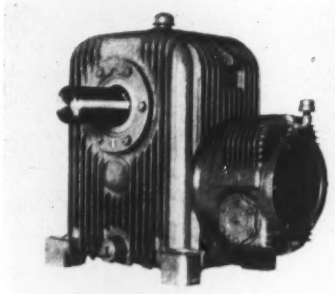
Automatic Control System

A new explosion-proof control system for petroleum and industrial liquid metering has been introduced by Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa.

According to the company, the system provides for automatic switch control of all pumps and quantity control valves right at the meter. Upon completion of a predetermined liquid delivery, a switch is automatically thrown, opening an electrical circuit and cutting off simultaneously all liquid flow at the meter and all pumping action.

The system includes a new accessory control switch, a predetermining register and latch box and quantity control valve—all installed at the meter.

Where repeated deliveries of a fixed amount of liquid are required, a special factory-set predetermining register is available. Details of the system are described in a two-page bulletin, OG-327, available from the company.



Double Reduction Units

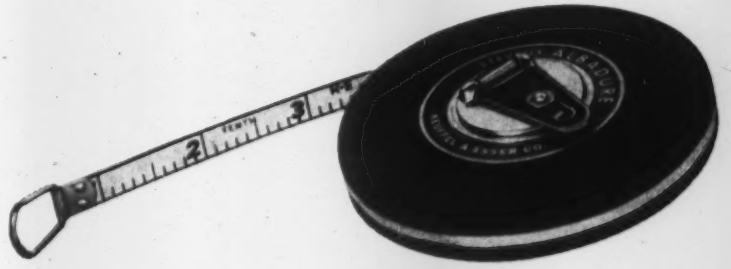
Four new and improved standard primary double-reduction units have been developed and added to the firm's line of double-enveloping worm gear speed reducers, it is announced by Cone-Drive Gears Div., Michigan Tool Co., 7171-E. McNichols Rd., Detroit 12, Mich.

The units are available in center distances of 2, $2^1/_2$, 3 and $3^1/_2$ in. Coupled with the proper secondary, they provide reductions from 25:1 to 3500:1, the firm reports.

The new models are said to provide a wide range of torque and reduction combinations, and are available with worm over or under, or gear shaft vertical in either right-hand or left-hand or double extended shaft assemblies. Primary units from 2 through 3-in. center distance are new standard housings containing standard gearsets, bearings, caps. Secondaries for these units are standard speed reducers using standard stocked components.

Water cooling coils can be installed in all sizes above 3-in. center distance for increased capacity, the company states. Primaries and secondaries are independently lubricated and have individual breathers, fillers and oil level gages.

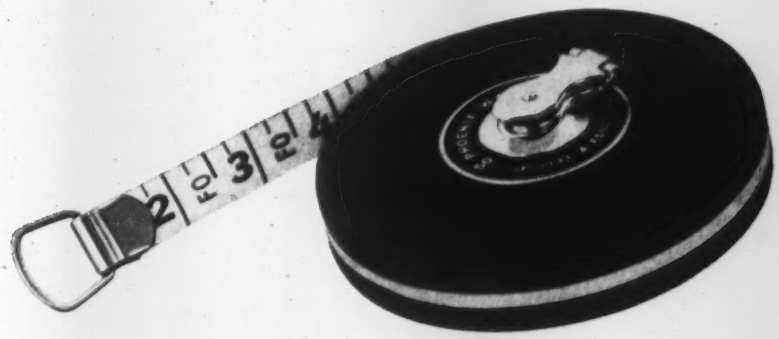
ALBADURE*... the steel tape with lasting legibility



Here is a steel tape that stays clear and legible long after markings on other tapes have worn off.

An amazingly tough plastic coating on both sides of the line protects the white background, the graduations and numbers on ALBADURE tapes, giving their surfaces tremendous resistance to abrasion and corrosion. To quote a State surveying party report, "If ALBADURE stood up in this tough mud and sand, it'll stand up anywhere." Available in all standard lengths, widths and graduations, in cases and on reels.

PHOENIX WYTEFACE®... the woven tape that outlasts others 3-1



PHOENIX WYTEFACE (non-metallic) Woven Tapes made from extra strong synthetic yarns, are harder wearing, with higher tensile strength and dimensional stability than ordinary woven tapes. A special plastic coating on both sides protects the line against hard use, water, stones or brush.

The end of the line is enormously strengthened by a lamination of Flexi-Foam, a spongy plastic-rubber. No stitches or hinge point to weaken the line.

A Highway Engineer reported of the non-metallic PHOENIX WYTEFACE, "It has at least three times the life of an ordinary metallic tape." *Ask Your K & E Dealer!*

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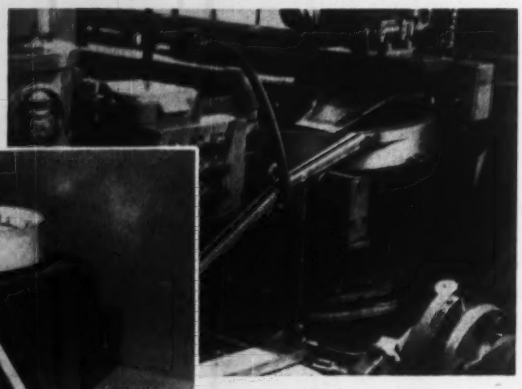
Feeding gear blanks to gear hobber.



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SYNTRON Vibratory Parts Feeders have broadened the once limited field of piece parts handling. Syntron Parts Feeders with their unique, gentle vibrating action and rheostat controlled rate of flow allows the handling of very fragile parts, such as thin walled glass bulbs, easily chipped ceramic parts, explosives, etc. This is impossible with mechanical feeders. SYNTRON PARTS FEEDERS are designed for long dependable service and simple, low cost maintenance. Easily adaptable to any automatic machinery operation, assembly, counting, inspecting, packaging, etc., that require single file feeding of small parts. Send sample parts to SYNTRON application Engineers for recommendations.

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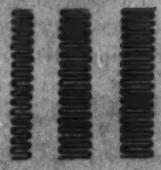
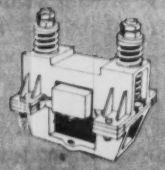
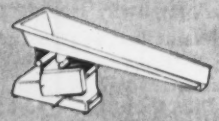


BIN VIBRATORS



VIBRATORY FEEDERS



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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

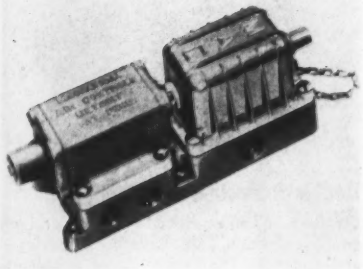
Compact Tractor

A compact, battery-powered tractor for both pulling and pushing operations in confined areas has been added to the Powrworker line of hand trucks produced by the Industrial Truck Div., Clark Equipment Co., Battle Creek, Mich.

The machine has a normal draw bar pull of 200 lb and a break-away rating of 700 lb. It has two speeds in both forward and reverse and will travel 2 mph fully loaded and 3.2 mph empty. Fingertip control levers are placed on the steering handle. The company says that although the tractor is designed as a "walkie" type, the operator can sit on the front cover for long runs.

Two models of different lengths are available. The PT-S, for single row battery, is 39¼ in. long, less coupler. The PT-D, for double row battery, is 44 ⅝ in. long, less coupler. Overall width of both models is 32 in. Weight, without battery, is 1150 lb.

A 12-v system powers a high torque series wound motor. Power from the motor is transmitted through a 22 to 1 double reduction of spur gears to the drive wheel axle. Various types of couplers are available optionally.



Air Valve

A new air valve designed to meet every JIC valve standard has been announced by Mechanical Air Controls, 10030 Capital, Oak Park, Detroit 37, Mich.

According to the company, this is the first air valve that not only meets but exceeds all JIC requirements, and it is the only valve with completely independent body and solenoid. Each can be removed separately from the base without disturbing the other. This is designed to eliminate confusion of responsibility between electrical repair and mechanical repair and also to simplify maintenance and part replacement.

The valve also features an integral conduit box to make it more compact and an improved solenoid with new shock-resistant mountings. The air chamber, spool and engineering are identical to that of all other of the firm's valves.

The new valve is available in ⅜ in. single-solenoid, double-solenoid and 3-way models.

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NEW EQUIPMENT
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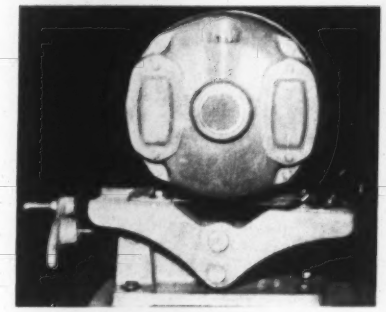


Tilting Motor Base

A new tilting motor base manufactured by Lovejoy Flexible Coupling Co., 4886 W. Lake St., Chicago 44, Ill., is designed to pull double duty with any variable speed pulley. The base compensates for belt tension when speed changes are made while the machine is running, the firm states, and it also makes belt changing an easier operation.

The unit features one size base for all fractional horsepower motors. Because of its tilting movement it requires only minimum space for adjustment. Actual base size is $5^1/_2 \times 7^1/_2$ in.

Correct belt tension and alignment are constantly maintained by a hand-wheel screw adjustment which changes the angle of tilt, the company says.

Miniaturized Gyro

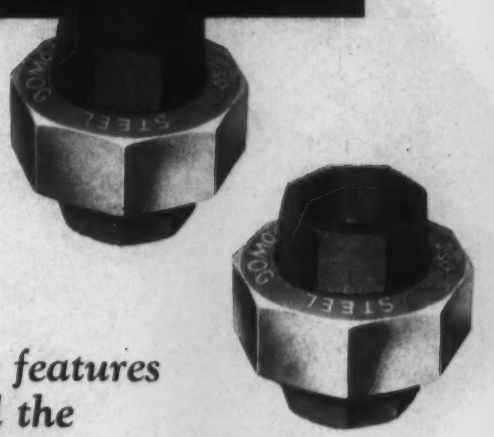
Norden-Ketay Corp., Commerce Rd., Stamford, Conn., announces its Model 55,000 floated rate gyro, designed to meet the environmental conditions encountered in missiles. Accuracy better than $\pm^1/_2$ per cent full scale can be obtained while the gyro is being subjected to the severe vibration environment specified for missiles, the firm states.

The gyro can be supplied in a variety of maximum rate ranges from 1 deg per second to 1000 deg per second. This gyro incorporates an inductive signal pick off, which provides a higher power signal output than has previously been available in this size rate gyro, the company says. The power signal output enables the use of minimum gimbal displacement, consequently yielding high natural frequency.

The gyro is completely filled with flotation fluid. According to the company, the flotation fluid serves three purposes: it reduces the load on the gimbal bearings; by providing flotation of the gyro rotor house, the flotation fluid insulates the gimbal bearings from shock and vibration; flotation fluid provides damping.

Damping ratio is maintained without a heater by a novel arrangement, which provides for varying the gap between the gyro rotor float chamber and an adjacent member. The damping ratio can be established to suit customer requirements and maintained within 0.1 over the temperature range of −55 C to 85 deg.

W-S Forged Steel Unions



. . . these features tell the difference . . .

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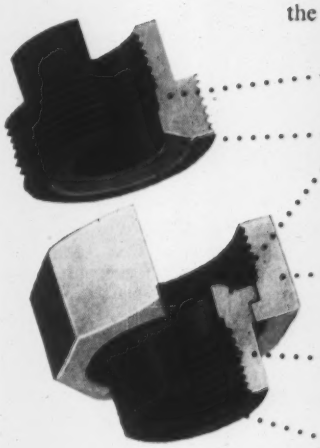

1 Designed to AAR dimensional specifications.

2 Steel-to-steel seats, with spherical-to-angle mating surfaces. Angle is rolled to extra hardness to resist galling.

3 Cadmium plated nuts for resistance to corrosion and to galling and siezing.

4 End pieces protected against rust by new W-S blue synthetic coating.

5 Octagonal end pieces for better gripping.

W-S Unions are machined from forged steel in accordance with ASTM material specifications A-105, Grade 2. They are available with screw-end and socket-welding end pieces in 3000 lb. class, sizes ⅛" to 3".

For complete information send for Bulletin U-1. Write to W-S Fittings Division, H. K. Porter Company, Inc., P. O. Box 95, Roselle, N. J.

HKP W-S FITTINGS DIVISION
H. K. PORTER COMPANY, INC.

Bubbles in boiling liquid were "frozen" with stop motion by photographer Bernard Hoffman.

Controlling Temperature in Fluid Engineering

Heat is generally only one part of your problem. Pressure, abrasion or corrosion factors usually must be taken into account, too. So if your past experience offers no precedent, you can look to S. Morgan Smith's specialized engineering leadership for assistance.

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There is a full SMS line – standard R-S Butterfly Valves ready for fast assembly and shipment from stock, Rotovalves and Ball Valves. A call to our nearest representative will bring information. Or, write S. Morgan Smith, York, Pa., for data on standard valves or special applications.

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Rotovalves • Ball Valves • R-S Butterfly Valves • Free-Discharge Valves • Liquid Heaters • Pumps • Hydraulic Turbines & Accessories

Oil Bath Air Cleaner

Four improvements in the company's new low resistance Cycoil oil bath air cleaner for smooth flow applications have been announced by American Air Filter Co., Inc., Dept. PD., Louisville 8, Ky.

The latest model of the Type P low resistance-high efficiency cleaner is said to offer a redesigned base for easier and less expensive installation; improved protection at the air intake against snow and water; greater bug protection; and redesigned and improved vari-flow valves.

According to the company, thorough mixing of oil with intake air and positive draining from filter pads insure that 100 per cent of the damaging dust is removed. These new features, plus other advantages such as the perforated entrainment plate principle, provide complete dust protection for super-charged engines and centrifugal compressors, the firm states.

Torque Motor

A new torque motor designed for tape recorder take-up reel drive is now available from Dalmotor Co., 1375 Clay St., Santa Clara, Calif.

The new motor is said to be capable of withstanding stall currents continuously, with extremely long life, and has a nearly linear speed-torque curve to stall. No-load speed is 2150 rpm. Double shielded, factory lubricated ball bearings are used. It weighs $5^1/_4$ lb.

Direct-Drive Chillers

A series of nine, new direct-drive Flow-Therm packaged liquid chillers, with capacities ranging from 20 to 125 tons, has been announced by Acme Industries, Inc., Jackson, Mich.

An innovation, according to the company, is a completely enclosed, tamper-proof control panel of improved design. All controls are grouped within a protective steel cabinet which has a hinged door with an integral padlock hasp.

A second innovation claimed by the firm is a system of pilot lights which warn the operator of open limit switches.

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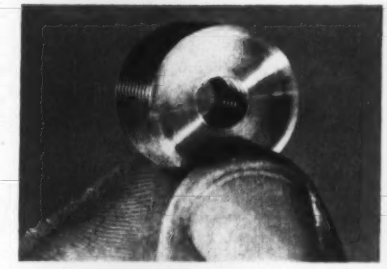


Precision Bellows

Belfab Corp., 11 Ramah Circle, Agawam, Mass., announces availability of extreme flexibility bellows with wall sections as thin as .002 in. Available in any weldable metal, and made on automatic machinery, these new precision bellows permit miniaturization never before possible, the firm claims.

The bellows illustrated, approximately $^3/_4$ in. OD × $^1/_4$ in. ID × $^1/_2$ in. long has a spring rate less than 7 lb per inch.

Submerged Pump

Brown & Sharpe Mfg. Co., Providence, R. I., has announced a new vertical submerged type centrifugal pump called the Midget Hi-Flow.

The pump is equipped with an integral $^1/_8$ hp 3-phase or $^1/_{10}$ hp single-phase motor. The motor is totally enclosed with a NEMA standard flat face mounting and is designed for continuous duty.

The unit is designed for immersion in liquid to a depth of $5^3/_4$ in. with the motor mounted 2 in. above the maximum liquid level. The liquid flows from the impeller through two cored passages within the pump body, with a $^1/_2$ in. pipe connection above the mounting flange.

According to the firm, the pump is suitable for supplying coolant for machine tools and light machinery, for use where dirt or abrasives may be present in the liquid, and for light transfer work.

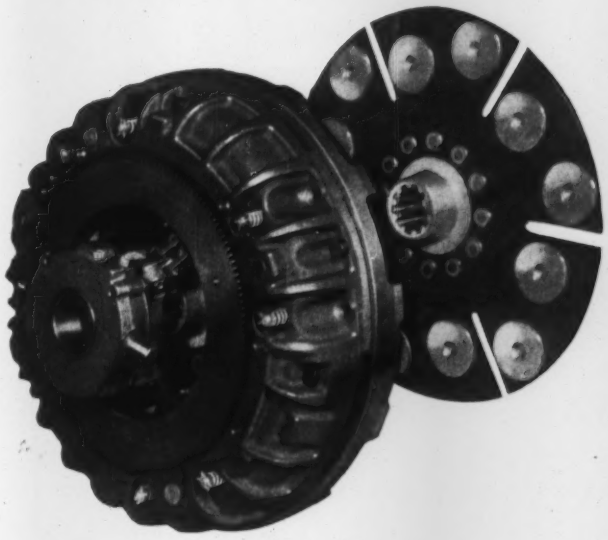
Automatic Battery Charger

A 60-cell automatic battery charger has been developed by the Walker Div., Norma-Hoffmann Bearings Corp., Stamford, Conn., for use at unattended substations and other locations when stand-by batteries have to be ready for immediate use.

The new charger has no moving parts. According to the firm, the charger eliminates gassing and water loss. The selenium rectifiers have inorganic, nonoxidizing barrier layers which are corrosion and moisture proof and are capable of continuous full load operation in 50 C ambient temperature without deterioration. The high gain magnetic amplifier control circuit automatically regulates output voltage to ±1%. The rectifier power circuit is full wave.

The charger is available in 3, 6, 12, 30 and 60 amp models.

ROCKFORD
OVER-CENTER
CLUTCHES



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HIGH TORQUE
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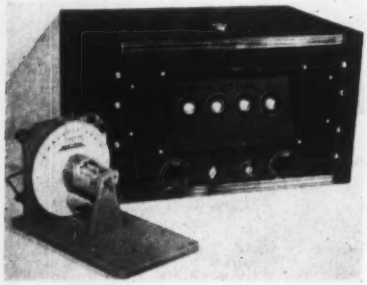
Pipe Insulation

Specifications for Mono-Kover, a slit, one-piece, sectional type molded mineral wool pipe insulation that snaps into place, are presented in a three-color bulletin published by the Baldwin-Hill Co., 214 Breunig Ave., Trenton 2, N. J.

In addition to describing the insulating properties of the material, the pamphlet explains and illustrates approved application methods. Thermal conductivity is shown graphically for every temperature throughout its operating range to 350 F. The bulletin lists and describes the various facings for the material which are available and presents, in tabular form, thicknesses recommended to insulate pipe sizes from $^{3}/_{4}$ to 24 in. according to temperature and type of application.



Tachometer, Dynamometer

Magtrol, Inc., Box 193, Bridge Station, Niagara Falls, N. Y., announces the development of new dynamometer to test completely shaded pole and induction motors for torque and speed characteristics.

The new unit operates on the principle of feed back torque control such that when a decrease in speed is detected by the tachometer generator of the unit, a corresponding decrease in load torque is instantaneously effected and the motor stabilized in any portion of the curve. Motors may be tested for maximum speed down as low as 100 rpm without any additional controls or adjustments being made, the company states.

Speed is continually monitored on the electronic tachometer which will consistently indicate true motor speed at accuracies of one-half of one per cent or better, the firm says. Speed pickup is photoelectric, and no error due to tachometer generator or spurious magnetic losses is reported.

The dynamometer has the running torque of the motor balanced against a carefully calibrated pendulum weight. No springs, dampers or other mechanical linkages are used in the torquing system.

Seven basic dynamometers with torque ranges from 750 oz-in. or as low as 1 oz-in. full scale may be obtained. The tachometer generator can be supplied to indicate speed up to 8000 by 1 rpm increments, or 30,000 rpm by 10 rpm increments. Basic tachometer accuracy is reported to be the same for either range.

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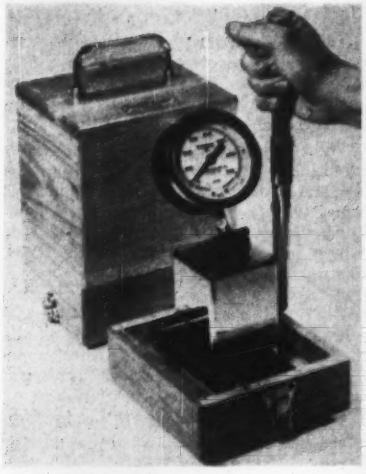


Torque Wrench Calibrator

A hydraulic torque wrench calibrator capable of testing torque wrenches to within 1 per cent of accuracy of full scale reading has been announced by Skidmore-Wilhelm Co., 442 S. Green Rd., Cleveland 21, Ohio.

The calibrator can be used anywhere in the shop, and is completely self-contained, the firm states. No electrical outlets or air feeds are needed.

In use, the operator puts his wrench in a coupling and turns it, creating a hydraulic pressure within the unit. This is measured by a specially calibrated hydraulic gage which makes readings directly in torque.

The unit comes in three sizes, each size having an option of two torque range readings. The smallest unit, weighing 7 lb, has torque readings of 0 to 200 in-oz, or 0 to 200 in-lb.

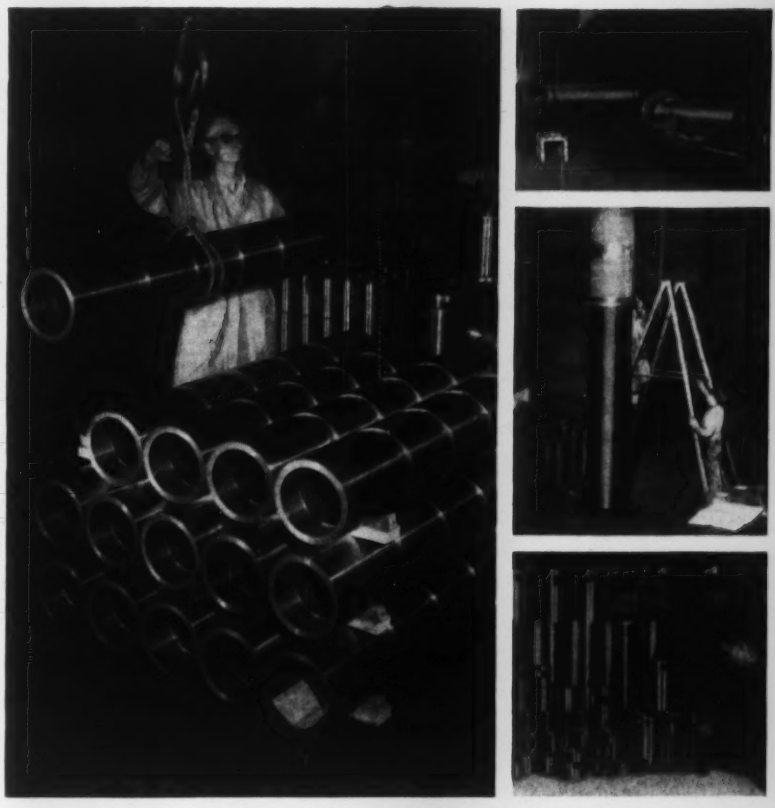
The second calibrator, weighing 14 lb, makes measurements in ranges from 0 to 60 ft-lb, or 0 to 150 ft-lb. The largest instrument, weighing 65 lb, measures from 0 to 600 ft-lb or 0 to 2000 ft-lb.

Stock Leveler

A new device for removing curvature from coiled stock has been introduced by Special Engineering Service, Inc., 8161 Livernois Ave., Detroit 4, Mich.

The light duty stock leveler was designed for use with the firm's air feed. It is non-powered and is intended for use with equipment which is powerful enough to pull coiled stock through the straightening rolls. It is stated that the stock leveler effectively removes coil curvature from stock up to 12 in. wide by .090 in. thick or 18 in. wide by .06 in. thick.

The leveler is built with three smooth finished rolls mounted on roller bearings. The upper roll of this tri-roll assembly is adjustable to provide a means of controlling the degree of flexing of the stock.



You save 5 ways with

SHENANGO CENTRIFUGAL CASTINGS

By using Shenango centrifugal castings for essentially symmetrical parts, you will gain considerable savings because:

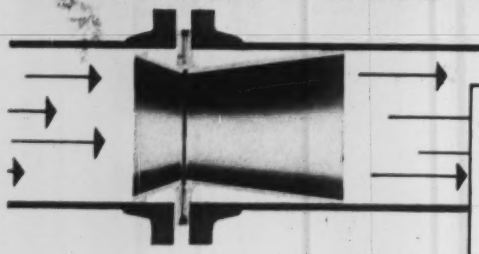
1. **The Shenango process automatically eliminates hidden defects in the metal . . . insures fewer rejects.**
2. **No patterns required . . . an important saving, particularly on special or small quantity runs.**
3. **Finer, more uniform grain structure means smoother, faster machining, better control, and a higher rate of completion.**
4. **With Shenango centrifugal method control, there's less excess metal to be machined away, less metal to buy and ship!**
5. **Because of their homogeneous, pressure-dense qualities, Shenango centrifugal castings are stronger, have better wear resistance and require less frequent replacement. Maintenance cost is cut!**

Check with Shenango on centrifugally cast parts for your needs —large or small castings . . . rough, semi-finished or precision-machined . . . ferrous or non-ferrous. They'll cost you less in the long run. For bulletins, write to: *Centrifugally Cast Products Division,* The Shenango Furnace Company, Dover, Ohio.

SHENANGO CENTRIFUGAL CASTINGS

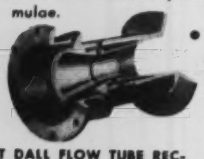
COPPER, TIN, LEAD, ZINC BRONZES • ALUMINUM AND MANGANESE BRONZES
MONEL METAL • NI-RESIST • MEEHANITE METAL • ALLOY IRONS

NEW TYPE FLOW METER CUTS PRESSURE LOSS BY 93.5%*



Get low cost flow metering with **Builders Dall Flow Tubes** — the primary element with the lowest pressure loss of any velocity-increasing differential producer!

- Greater instrument accuracy through higher differentials at the lowest total head loss.
- Fabricated design allows wide construction material choice to meet exact process specifications.
- All critical surfaces precisely machined to Dall formulae.
- *Enduring accuracy through self-scouring, durable construction.*



CAST DALL FLOW TUBE RECOMMENDED FOR WATER WORKS AND SEWAGE INSTALLATIONS

***Here's How!**

Builders Dall Tube #12D in 12" pipeline — max. differential 80" — max. flow 3900 GPM.	Pressure loss at max. flow— 2" of water
Orifice plate in 12" pipeline for same max. differential and flow	Pressure loss at max. flow— 31" of water
	Pressure loss saving with Dall Flow Tube — 93.5%

(On one installation, this saving produced pumping power cost reduction of $560.00 each year.)

Request Bulletin 115-DM1, from **Builders-Providence, Inc., 382 Harris Avenue, Providence 1, R. I.**

BUILDERS-PROVIDENCE
DIVISION OF
B-I-F INDUSTRIES
METERS FEEDERS CONTROLS

ENGINEERS: THE WONDERFUL COMMERCIAL JET ERA IS OPENING UP AT TWA

If you are seeking an opportunity to further your career with a fine company . . . look no further.

TWA presently has openings for Aeronautical, Mechanical, Electrical and Electronic Engineers to work with a small, select group of engineering associates. This arrangement gives each engineer the opportunity to demonstrate his ability and to advance within the company . . . the opportunity to build his future with the world's finest airline.

Qualifications: B.S. in Engineering.

Location: TWA's ultra modern building now nearing completion at Kansas City, Mo.

Living Conditions: Excellent, both city or suburban private homes or apartments.

Benefits: Many employee benefits, including liberal free transportation for yourself and family each year.

Salary: Commensurate with experience.

If you are an engineer with qualifications in any of these fields, explore your opportunity with TWA today. Write:

Mr. R. Paul Day, Employment Manager

TRANS WORLD AIRLINES

Kansas City 5, Missouri

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

High Temperature Solders

Two new high temperature soldering materials which the company says promise to cut joining costs for aluminum fabricators, are announced by Aluminum Co. of America, 795 Alcoa Bldg., Pittsburgh 19, Pa.

The new products, performance-tested by extensive pilot applications, are Solder No. 805, and Soldering Flux No. 66. A high zinc solder (95 per cent zinc, 5 per cent aluminum), the new product has been used successfully in joining heat exchanger return bends, electrical connections, automobile radiators, solder sheet assemblies, transition joints, and fins to tubing, the company states. The material is said to be capable of joining all aluminum alloys, and make joints between aluminum and other metals such as copper, brass, steel, stainless steel, nickel.

With a melting range of 715 to 725 F, the new solder can be heated by any of the conventional methods. It works most effectively when preplaced in or near a joint, rather than being fed manually.

According to the company, strength of the highly corrosion-resistant joints made with Solder No. 805 is directly dependent on lap length, with a length twice the thickness of the thinnest aluminum member suitable for most applications. No. 805 could reduce joining costs by effecting high temperature joints that formerly had to be brazed or welded, the firm states.

Soldering Flux No. 66, recommended for use with the new solder, can be applied dry, or as a 70 per cent flux—30 per cent normal propyl alcohol solution. It reacts at 720 F to wet aluminum with zinc, and there are no restrictions regarding the method of heating. Immediately following the soldering operation, the flux can be removed by flushing with water heated to 180 F.

Electronic Reset Timer

Eagle Signal Corp., Moline, Ill., announces its No. 150 Electroflex electronic reset timer, designed to time short intervals from .05 to 10 sec. Its only moving parts are the armatures of two relays, the company reports.

The dial is calibrated directly in seconds and may be set with a high degree of accuracy, the firm states. Timing accuracy is maintained within 2 per cent of the initial setting, taking into consideration voltage variations of −15 per cent to + 10 per cent ambient temperature changes of 70 F to 140 F, tube replacement and/or nominal vibration and humidity.

According to the company, all timer components are accessible, and the timer adapts itself easily to the firm's accessory plug-in mounting kits which may be used interchangeably with synchronous motor timers and impulse counters.

Remote control is available in two variations. The dial may be removed from the timer and located remotely. A kit is available for remote control dial of relative size to a pushbutton station.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

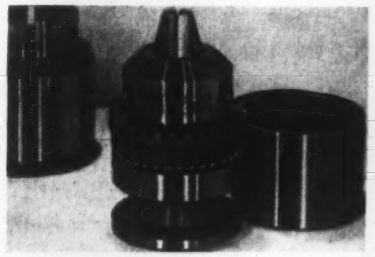
Space Saving Motors

A new line of space saving motors has been announced by Peerless Electric Co., Warren, Ohio.

They are available in single-, two- and three-phase. Single-phase models are rated 50/60 cycles, 115/130 v, constant speed, continuous duty, drip proof 50 C, enclosed fan cooled 55 C, from $^1/_2$ to 3 hp.

Two- and three-phase models are 50/60 or 20 cycles, 110, 208, 220/440 or 550 v, constant speed, continuous duty, drip proof 40 C, enclosed fan cooled 55 C; $^1/_2$ to 5 hp.

The units meet all NEMA standards. They have prelubricated double shielded type ball bearings. Special torques, mountings enclosures and duties are available.



Ball Bearing Chucks

Supreme Products Corp., 2222 S. Calumet Ave., Chicago 16, Ill., announces its Series 20 ball bearing geared chuck line. Two new gear chucks which have a friction free ball thrust bearing between the chuck body and gear-nut, the company states.

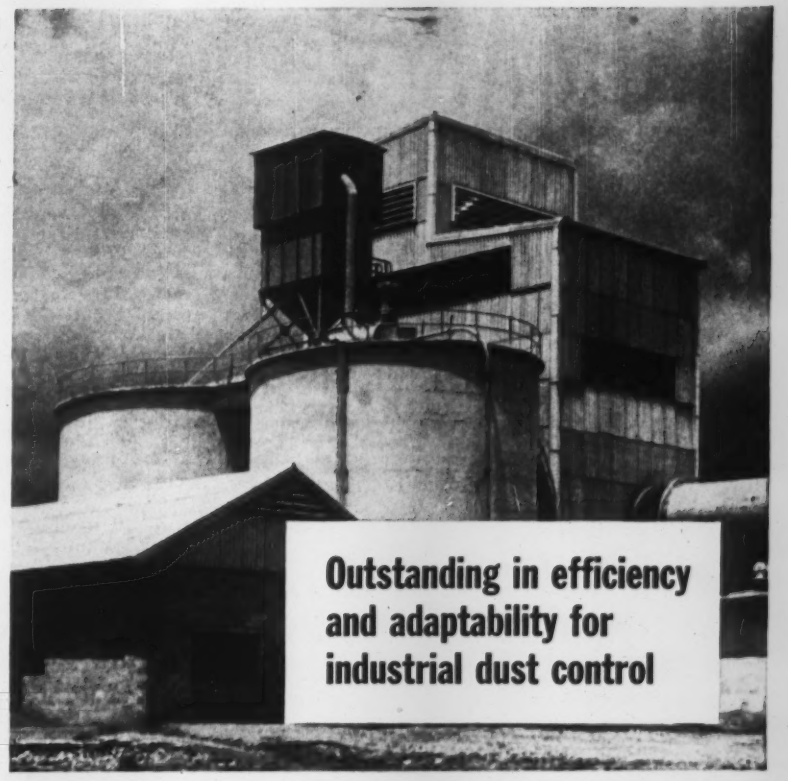
With the same key tightening effort, chucks in the series line will grip with much greater force than any plain bearing chuck, it is claimed. The ball races are formed directly in the hardened chuck body and in the one piece gear-nut. According to the firm, the units have a smooth sleeve, so there is nothing on which clothing or other materials can be snagged; and hands and knuckles are less likely to be hurt when chuck is touched accidentally.

High Speed Press

A 140-lb electro magnetic high speed press for punching, jolting, drawing, bending, riveting, cutting or stamping has been announced by McCauley Industrial Corp., 1840 Howell Ave., Dayton 7, Ohio.

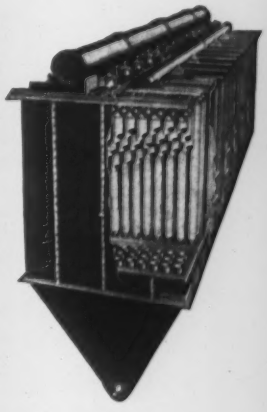
Stroke adjustment permits a choice of single stroke operation or of multiple stroke operation over a range of 10 to 200 strokes per minute, the company states. Force of impact can be adjusted from 600 lb to $3^1/_2$ tons.

The power unit is an electric magnet. A movable iron core traveling within the magnet acts as a ram. According to the company, this type of construction eliminates the use of moving parts subject to mechanical wear and fatigue stresses.



Norblo *Automatic Bag Type*
DUST ARRESTERS

Wherever it is important that you have continuous high recovery of industrial dusts and fumes — for salvage or for good housekeeping — Norblo Automatic Equipment brings you many design advantages.



Here is dependable heavy duty collection service at low cost of operation and maintenance that pays for itself quickly. The principle of cyclic bag shaking and cleaning has proved itself for outstanding efficiency. Adjustment for varying dust loading can be made in a few minutes without shutting down.

If you have a dust problem or dust creating process that needs control, write us for free suggestions based on experience of over 40 years.

Norblo also builds centrifugal and hydraulic dust collectors, cement air cooling systems, and portable type dust collectors.

The Northern Blower Company
6421 Barberton Ave., Cleveland 2, Ohio • OLympic 1-1300

Norblo ENGINEERED DUST COLLECTION SYSTEMS FOR ALL INDUSTRIES

THOMAS
FLEXIBLE COUPLINGS
Give You Freedom From Coupling Maintenance

NO LUBRICATION

NO MAINTENANCE

NO WEARING PARTS

Future maintenance costs and shutdowns are eliminated when you install Thomas Flexible Couplings. These all-metal couplings are open for inspection while running.

They will protect your equipment and extend the life of your machines.

Properly installed and operated within rated conditions, Thomas Flexible Couplings should last a lifetime.

UNDER LOAD and MISALIGNMENT ONLY THOMAS FLEXIBLE COUPLINGS OFFER ALL THESE ADVANTAGES.

1 Freedom from Backlash Torsional Rigidity
2 Free End Float
3 Smooth Continuous Drive with Constant Rotational Velocity
4 Visual Inspection While in Operation
5 Original Balance for Life
6 No Lubrication
7 No Wearing Parts
8 No Maintenance

Write for Engineering Catalog 51A

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U.S.A.

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Circulating Supply Pump

An air-powered pump designed to agitate, pump and circulate metallic base and similar paints direct from original 5–10 gal pails to spray gun and back to pail without exerting pressure on, or in, the container has been announced by Gray Co., Inc., 1097 Sibley St. N. E., Minneapolis 13, Minn.

The new unit is specifically designed to keep metallic base paints in constant suspension—even when material is not being sprayed, the company reports. Separate, air-driven agitator and constant circulation through hoses is said to provide dual agitation in pail and assures constant uniformity and viscosity.

According to the company, the air-powered pump is spark free and automatically speeds up to compensate for spray gun demand while maintaining previously set fluid flow.

Venturi Blocks

A new style of venturi block designed to supplant vacuum pumps in the lifting and moving of parts by vacuum has been developed by the Stilson Tool Corp., 30233 Groesbeck Highway, Roseville, Mich.

The new venturi block is designed without moving parts. Using present air compressor equipment, the blocks in combination with vacuum cups, permit adaptation of present production equipment to automation methods, the company states.

The venturi is constructed from aluminum alloy and is machined to precise tolerances.

It is said to operate at peak efficiency on 35 to 40 lb of air pressure.

Air, Water Cylinders

A. K. Allen Co., 57 Meserole Ave., Brooklyn 22, N. Y., introduces under its Allenair trademark a new line of cylinders designated as Type B.

The cylinders are for air, water or hydraulic service and are available in bores of 1½, 2, 2½, 3 and 4 in. and with either single ended or double ended rods. All sizes are also available as double acting cylinders or single acting spring return ones.

The cylinders have either brass or steel barrels, both treated for corrosion resistance, stainless steel rods and Nylined bearings. Cushions are available for both ends as well as interchangeable foot, flange, and swivel mounts to permit mounting in any manner or position.

According to the company, unusual compactness and ease of disassembly of the cylinders is achieved by the fastening of the heads squarely and rigidly to the tube with commercial rectangular section, hardened-steel snap rings reground flat and parallel.

For Consulting Engineers Turn to Page 146

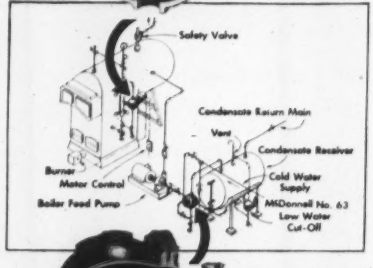
Here's the Great Combination for those...

Medium Pressure Boilers
(up to 150 lbs. psi.)

The No. 150 controls the boiler feed pump the one right way—directly from the boiler water level. Holds boiler level within close limits to assure maximum steaming efficiency and fuel economy. Has extra switch which provides circuits for cutting off burner and sounding alarm in case of low water emergency. It's the most widely-used, time-proved control of its kind.

Underwriters Listed
C.S.A. Approval No. 5545

McDONNELL No. 150 PUMP CONTROL



McDONNELL No. 27T MAKE-UP FEEDER

Adds water to condensate receiving tank whenever necessary to make up for any deficiency in returns. Large feeding capacity meets any sudden boiler demand for water. Needle and seat are stainless steel assuring powerful drip-tight closure. For tank pressures to 35 psi., supply pressures to 100 lbs.

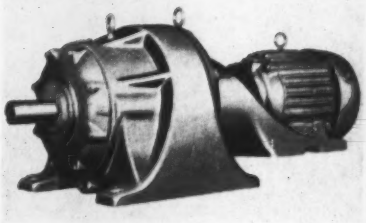
Write for simple installation and wiring diagrams

McDONNELL & MILLER, INC.
3510 N. Spaulding Ave., Chicago 18, Ill.

Pioneers Over Thirty Years
McDONNELL
Boiler Water Level Control and Safety Devices

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS



Gear Unit

A new packaged power unit, meeting JIC requirements for operations that require a standard NEMA motor mounted separate from the gear unit, has just been placed into production by U. S. Electrical Motors Inc., Box 2058, Terminal Annex, Los Angeles 54, Calif. The new unit, designated as the Motomount Syncrogear, uses a heavy duty, cast-iron motor support designed to provide easy access to the motor mounting and coupling.

Replacing the motor may be quickly accomplished, but the change is not limited to the original type of motor, the firm states. If requirements change, any enclosure of the same NEMA dimensions and rating may be used.

Features of the unit include a solid cast-iron, one-piece case, normalized castings, through-hardened gears with gear teeth micro shaved, friction-free oil seal, pyramidal mounting base, dip lubrication, and a solid shank high-speed pinion.

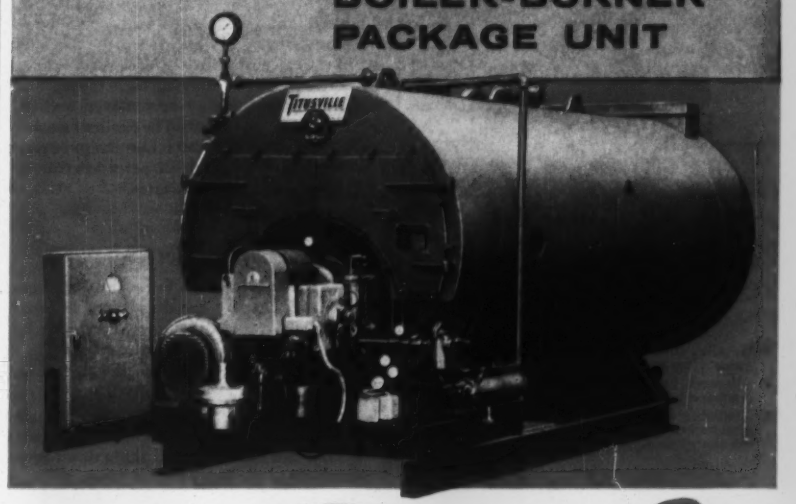
Feeding Device

A new high-speed method for automatic elevating, orienting and feeding of parts to automated production lines has been developed by the Gear-O-Mation Div., Michigan Tool Co., 7173 E. McNichols Rd., Detroit 12, Mich.

The method uses a combination feeding unit that will handle parts that roll or slide, such as gears, cylinders, and spiders. The company says that although the equipment is custom-tailored to a specific job, it is assembled from standard components. These feeders are said to be adaptable to any part feeding job, especially for feeding parts to individual machines.

In operation, parts are conveyor fed or truck dumped into the hopper section of the unit. From there, they are scooped onto slanted shelves for elevating and feeding to a distribution system. When elevated, properly positioned parts roll through; improperly positioned parts are chuted again to the hopper as they fall free on the back side. Before passing into the main distribution system, parts from the elevator are again checked as to orientation by being passed over a narrowed track. If not in line they drop off and are returned to the hopper, the company reports.

NOW...THE TITUSVILLE 3pass BOILER-BURNER PACKAGE UNIT



WITH 80% PLUS CERTIFIED EFFICIENCY!

As pioneer and master-builder of Scotch Marine type boilers, TITUSVILLE is proud to present the 3-PASS boiler-burner package unit for high and low pressure and hot water. Offering the highest efficiency obtainable, these new 3-Pass boilers provide economy in service so great as to return the entire investment cost over a few years of operation. Designed for use with any of the leading makes of burners, and for gas, oil, or gas-oil combinations, Titusville 3-Pass boiler-burner units are available in ten sizes, with heating surfaces from 358 to 3571 sq ft. Write for the facts, and a quotation on your requirements.

THE TITUSVILLE IRON WORKS CO.

BOILER DIVISION
BOILERS for Power and Heat . . . High and Low Pressure . . . Water Tube . . . Fire Tube . . . Package Units

PROCESSING EQUIPMENT DIVISION
Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels . . . Synthesis Converters

FORGE DIVISION
Crankshafts . . . Pressure Vessels . . . Hydraulic Cylinders . . . Shafting . . . Straightening and Back-up Rolls

MACHINERY DIVISION
MACHINERY for Sheet and Structural Metal Forming . . . Tangent Benders . . . Folding Machines . . . Roller Table and Tumble Die Bending Machines . . . Press Brakes . . . Punching and Notching Machines . . . Forming Dies

A Division of

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TITUSVILLE, PENNSYLVANIA

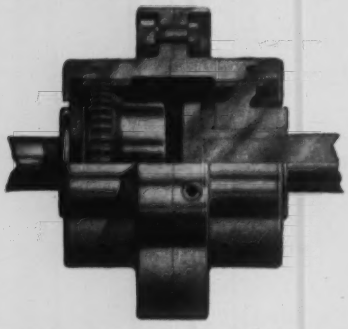
Manufacturers of A Complete Line of Boilers for Every Heating and Power Requirement

Plants at Titusville, Pa. and Warren, Pa.

Offices in Principal Cities

New FIRSTS are being made with AJAX DIHEDRAL COUPLINGS

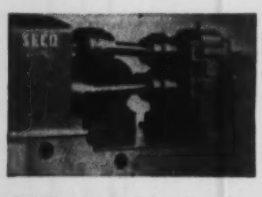
Designers and users of modern mills are achieving new high speeds (up to 7200 feet per minute), new high uniformity of gauge, new high quality finish, new high production and maintenance economies. Ajax patented dihedral tooth design is revolutionizing machine design and performance throughout industry. They are made in a wide range of types and sizes,—write for Catalog No. 62.



- Handles shaft misalignment... offset and angular... up to a total of 12 degrees.
- All teeth hardened to 50-55 Rockwell C to combine hard wear surface with tough core.
- Available in regular single and double engagement, mill motor, floating shaft and spindle shaft types.

This 37" x 80" 2-high temper pass mill is cutting tonnage costs in the Fairless Works of the U. S. Steel Corp., at Morrisville, Pa.

Ajax Floating Shaft Dihedral Couplings solve angular drive problems on tilting tables for the Green River Steel Corp., at Owensboro, Kentucky.



Two Ajax Dihedral Floating Shaft Couplings driving SECO 48" heavy duty slitter in operation at McLouth Steel Co., Detroit, Michigan, cutting ¼" stainless steel at 100 ft. per min. with 16" diameter knives.

AJAX FLEXIBLE COUPLING CO. INC.
WESTFIELD, N. Y.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Self-threading Nut

A new self-threading lock nut, which cuts its own threads on die-cast or cold-forged studs of nameplates, medallions, emblems, moldings, is announced by Palnut Co., Glen Rd., Mountainside, N. J.

The nuts are made of spring-tempered steel, comprising a thread-cutting lock nut and flat washer in one piece, in sizes for 1/8, 3/16 and 1/4 in. unthreaded studs. The nut is hex form which fits all standard tools and shanks. According to the company, it cuts deep, clean threads having high torque and tensile values and may be removed and reused on the same studs. The resilient-washer base assures 360 deg contact on flat or irregular work surfaces, and on perpendicular or off-angle studs, the firm states.

Metal-Turnings Feeder

A new metal-turnings feeder, designed expressly to eliminate the drawbacks incurred by manual feeding, has been introduced by Jeffrey Mfg. Co., Columbus 16, Ohio.

An electrically controlled motor cuts on and off according to the load. Dual star wheels feed the metal turnings into the crusher until the amp demand controls signal "Enough" and the feed shuts down temporarily until the surge load is passed.

The hopper, with a capacity of 2 to 3 cu yds, doubles as a storage bin since the feeder motor can be started under full load. The hopper fits every size of crusher from a ton per hour up to 20 tons per hour, the company says.

The feeder is supported directly on the metal-turnings crusher.

Air-Powered Hoist

A new 4000 lb capacity hoist has been added to the line of air-powered hoists made by Gardner-Denver Co.'s Keller Tool Div., Grand Haven, Mich.

Fitted with either roller or link chain, the lifting and lowering speed varies from a creep to 10 ft per minute at full load and 90 psig air line pressure. Length of lift is eight ft and the hoist operates with either a one-hand control bar or remote pendent control. According to the firm, the axial-piston compressed air motor assures positive starts and stops, prevents motor burnouts during stalls, and a centrifugally governed, fully mechanical brake prevents slippage. When the air supply fails or maximum lowering speed is exceeded, the brake design permits the operator to retain control of the hoist while lowering the load, the company says.

The hoist weighs 100 lb, is equipped with swivel-mounted safety suspension and load hooks. Hook-to-hook dimension is 23 1/2 in. Accessories for the hoist include trolleys for the hoist and air hose, a chain basket with a 20-ft capacity, filter-regulator-lubricator and a non-sparking kit to adapt the hoist for operation in explosive atmospheres.

ENGINEERS

Mechanical, Electromechanical

Information manual about APL and its programs now available

The Applied Physics Laboratory (APL) of The Johns Hopkins University is unique in that we are neither an industrial nor an academic organization, but rather a composite, having drawn freely from the methodologies of each.

For thirteen years APL has pioneered in guided missiles. Today we are engaged in a broad program of R & D for the Navy; in addition, we are responsible for technical direction of industrial and academic contractors in developing the Terrier, Talos and other major weapons and weapons systems. Our staff members enjoy not only the stimulus of association with their immediate colleagues at APL, but also with those in other organizations of considerable stature.

NEW 30-PAGE PUBLICATION

A few positions for senior engineers and scientists are now open. Information on our accomplishments and goals is available in a new 30-page publication, just off the press.

In it staff leaders representing each of the various disciplines and fields outline the nature of their programs. Information on our new laboratory in Howard County, Md. (equidistant between Baltimore and Washington) is also included, together with facts on the outstanding communities in which our staff members live.

Quantity is somewhat limited. May we suggest you send now to: Professional Staff Appointments,

The Johns Hopkins University
Applied Physics Laboratory

8607 Georgia Avenue, Silver Spring, Md.

YODER SLITTERS Supply Varied Strip Widths for Tinnerman *Speed Nuts*®

Tinnerman Products, Inc., Cleveland, Ohio, produces more than 10,000 different shapes and sizes of "SPEED NUT" brand fasteners for industry . . . many of them to special specifications.

To do this, Tinnerman uses slit steel strands ranging in width from ⅛" to 7½". To carry an inventory of the many strip widths required to meet normal and unusual demands would be almost impossible.

Tinnerman overcomes these inventory and supply problems by doing their own slitting on two Yoder slitters. This enables them to supply the plant with any strip size required from a relatively small inventory of 6" and 9" width purchased coils. In slitting narrow strands, such as these from small coils, a Yoder slitter may be profitable on a production as low as 25 tons per month.

Here is a fine example of how a small investment in Yoder slitting equipment greatly simplifies and speeds production while effecting important operating economies.

The saving made in time alone, reflects in better customer service through faster completion and delivery of finished products.

If your steel strip or sheet slitting requirements are as low as 100 tons per month or even less, a medium size Yoder slitter can be a very profitable investment for you. The Yoder line includes units of every size and capacity . . . of the most advanced engineering design. Send for the Yoder Slitter Book —a comprehensive text on the mechanics and economics of slitters and slitting line operation, with time studies, cost analyses and other valuable data. Write to:

THE YODER COMPANY
5499 Walworth Avenue • Cleveland 2, Ohio

YODER ROTARY SLITTING LINES

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Circuit Breaker

A weatherproof, precision type, heavy duty circuit breaker for use in aircraft, trucks, buses, transformers and ground-powered generating equipment is in production at the Spencer Thermostat Div. of Metals & Controls Corp., Attleboro, Mass.

It weighs 7.5 oz and is designated Klixon C7855. The unit has as its actuating element the firm's snap-acting disk. Ratings in C7855 series range from 105 to 200 amp. Each circuit breaker is individually calibrated.

According to the company, automatic and manual reset types operate at predetermined current overload. Excess current passing through the disk causes it to heat to tripping temperature and snap into reversed curvature, opening the contacts and breaking the circuit. In automatic reset types, the disk automatically reverts to its original curvature after a short cooling time, and the circuit is re-established.

If overload conditions persist, the breaker continues to reopen and cycle until overload conditions are corrected. Manual reset types operate similarly except when the circuit is broken; it remains so until manually reset by push button. Contacts cannot be held in closed position by the trip-free reset button if overload conditions persist.

Speed Recorder

A new recorder developed by General Electric Instrument Dept., Schenectady 5, N. Y., measures and records speed with an accuracy of ±0.1 per cent of measured speed.

Designed for use with the company's d-c tachometer generators, the new recorder can be calibrated in rpm, fpm, or other similar units, the company reports.

The recorder's accuracy is accomplished by measuring the difference between the tachometer voltage and a voltage from a precision reference contained in the instrument, effectively expanding the instrument scale. A multi-position switch is used to change the value of the reference voltage in steps, resulting in a different degree of expansion for the instrument.

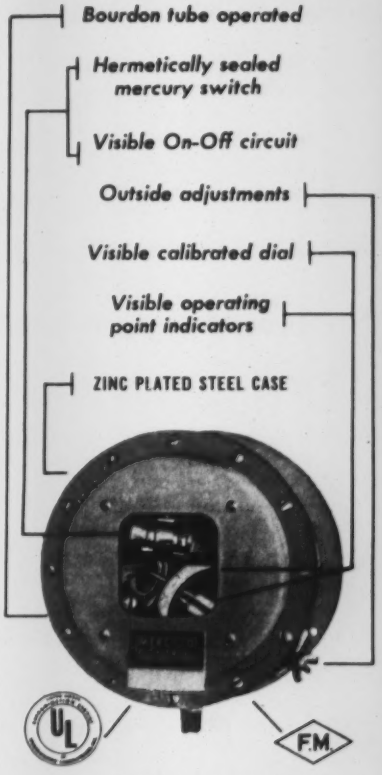
Standard speed recorders, the firm explains, with ranges of 0–1000 rpm have an accuracy of ±0.25 per cent of span. Using the new high-accuracy recorder, this total span is divided into 10 steps: 0–100, 100–200, 200–300, and so on to 900–1000. Each step will cover the entire scale and have a span accuracy of ±0.25 per cent, but the accuracy based on the 0–100 span would be $^1/_{10}$ of this value, or 0.025 per cent.

There is an additional error (not more than 0.1 per cent) from the reference voltage and precision resistors, plus the usual tachometer errors.

A variation of this instrument records per cent deviation from a desired speed with the same ±0.1 per cent accuracy if such measurement is preferred.

MERCOID® WEATHER PROOF CONTROLS

For PRESSURE – TEMPERATURE



FOR OUTDOOR APPLICATIONS
NEMA 1A, 2, 3, 4

Available in various operating ranges with differentials to meet your requirements.

WRITE FOR BULLETIN 6-18

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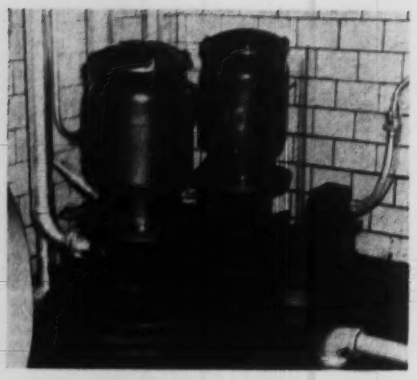
THE MERCOID CORPORATION
4201 BELMONT AVE., CHICAGO 41, ILL.



WHY
Nagle® Pumps
STAY ON THE JOB, CUT MAINTENANCE COSTS, FOR IRON AND STEEL PRODUCERS

These two Nagle 1½" Type "SW-B" pumps handling ammonia liquor at United States Steel's Clairton Works, are among 45 Nagles at this plant, in various abusive applications —typical of the many steel producers using Nagles.

Nagle Pumps have design features which minimize shut-downs and maintenance costs—simple slippage seal adjustment; sleeve bearings replaceable without dismantling pump; no stuffing box, smooth, surgeless flow of material; all parts in contact with material pumped are of metal or alloy most suitable for the abrasive, corrosive or high temperature conditions involved. Vertical and horizontal types for *every* abusive application. Send for Catalog 5206.

NAGLE PUMPS

NAGLE PUMPS, INC.
1299 CENTER AVE., CHICAGO HEIGHTS, ILL.

PUMPS FOR ABRASIVE AND CORROSIVE APPLICATIONS

devoted to Research
GYRO ASSEMBLY AND TEST

Mechanical and Electrical Engineers, with a personal interest in precision mechanisms, where a high degree of accuracy is required, and a pride in the precision of the product they help build, we offer truly challenging opportunities.

You will do development work and testing in one of the country's most versatile laboratories, working with the top men in the field and the finest test, research and development equipment. As a part of our Major, Permanent, Expansion Program, new plant facilities are being added in suburban Milwaukee.

AC provides financial assistance toward your Master's Degree. Graduate program also available evenings at Univ. Wisconsin, Milwaukee. GM's aggressive position in the field of manufacture and GM's policy of decentralization creates individual opportunity and recognition for each Engineer hired.

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Milwaukee offers ideal family living in a progressive neighborly community in Southern Wisconsin.

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Mr. Cecil E. Sundeen, Supervisor of Technical Employment
THE ELECTRONICS DIVISION
GENERAL MOTORS Corporation
FLINT 2, MICH. **MILWAUKEE 2, WIS.**

Roller Conveyor

Production of a new aluminum 1.75 in. roller conveyor is announced by Rapids-Standard Co., Inc., 342 Rapistan Bldg., Grand Rapids, Mich.

Firms working particularly in high humidity conditions or involved in handling high explosive materials can realize the non-corrosiveness and nonsparking advantages of aluminum construction with the new unit, it is reported.

Welding Power Sources

Two new Fillerarc welding power sources, designed specifically for consumable electrodes gas shielded welding, have been announced by General Electric Co., Welding Dept., Schenectady 5, N. Y.

Both the constant arc length and the constant voltage motor generators are rated 450 amp, 60 cycles.

Two-high stacking of the new units makes possible considerable savings in floor space, according to the company. Other features of both units are redesigned fan and baffled air ducts for reduced noise levels; complete phase insulation of motor stators for increased life; oversized sealed bearings; and constant pressure brushes, for correct settings.

Four 1-in. tie rods connect bearing housing, magnet frame, and fan housing in accurate, rigid alignment. All control components are accessible by removing the top cover, the company reports.

The constant arc length welder, with a rising volt-ampere characteristic, virtually eliminates burn-back and stubbing, according to the company. With controls only for setting arc length, the self-regulating unit will automatically supply the proper current for any wire feed speed required.

Setting the wire feed speed controls welding heat, since the generator automatically supplies the proper current to melt off whatever wire is being fed. The operator can change wire feed while welding, without readjusting other settings.

A special reactor controls current peaks when welding with carbon dioxide on mild steel. This greatly reduces spatter and results in cleaner welds, even in out-of-position welding, according to the firm.

The second new power source, the constant voltage motor-generator, decreases the chances of stubbing and burn-back, and is more suitable for consumable electrode gas-shielded welding than standard motor-generators with a drooping volt-ampere curve, the company says.

This unit holds arc voltage constant throughout the welding range, independent of line-voltage fluctuations. Welder adjustment may be required when wire speed is changed. The special reactor for control of current peaks when welding with carbon dioxide and mild steel is available as optional equipment on the constant voltage unit.

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Electric Power Absorber

A new electric power absorber is being marketed by Sun Electric Corp., 6323 N. Avondale, Chicago 31, Ill.

The unit is a small cylinder, which replaces 27 500 w stick resistors. It takes up only 1/25 of the space such a bank of resistors would occupy, company reports.

The power absorber operates at 13,500 w continuous duty; its weight is 1 lb per kw absorbed. Air is drawn in through circumferential slots in the casing, and flows over specially designed V-section resistors. The motor and fan can be operated either as part of the load, or from an independent power source. The power absorber is fully protected against overload, the firm states.

Adaptations of the unit are in use in the "Redstone" and "Snark" missiles programs.

Outer Race Bearings

General Bearing Co., 47 Roselle St., Mineola, N. Y. announces the availability of a variety of outer race materials on its full line of commercial bearings.

Stud, bore, flange and special bearings can be supplied with nylon, rubber or laminated phenolic tires. Outer race materials can be molded or pressed fit to the basic steel outer race and the resultant combination affords the wearability of steel plus the silent operation of rubber, nylon or phenolic, the company states.

The manufacturer adds that the application of nonmetallic outer races to ball bearings will appreciably lessen the wear on contacted surfaces.

Pipe, Block Insulation

A line of pipe and block insulation, with the tradename Thermasil for temperatures up to 1200 F is announced by Ehret Magnesia Mfg. Co., Valley Forge, Pa.

The material is a hydrous calcium silicate compound, blended with other selected inorganic ingredients which are reinforced with long asbestos fibers. It is a molded insulation and is chemically converted under controlled conditions to form a strong, hard, light, chemically stable material, the company says. The material is said to be nonflammable and unaffected by water or excessive water vapor.

It is offered in sectional pipe form for pipe covering and in block form for insulation of equipment. Pipe insulation is available in all pipe sizes up to 18 in. According to the firm, simplified thickness standards make it possible for every pipe size and wall thickness to fit precisely over or inside another pipe size. For pipe sizes over 18 in., the insulation is supplied in segmental form.

Block insulation is supplied in 18 or 36-in. lengths with thicknesses of 1 or 1 1/2 in. for 6-in. width blocks, and with thicknesses of 1 1/2, 2, 2 1/2, and 3 in. for 6 or 12-in. widths.

No hard-to-reach board areas with . . .

auto-shift

Here's the table that allows a draftsman to reach (and work on) any part of his board, easily, while sitting or standing! And here's how it's done. Two simple controls adjust board height and slope—move any area of the board instantly, effortlessly to the most convenient working position. Draftsman fatigue is sharply cut down, productivity dramatically steps up.

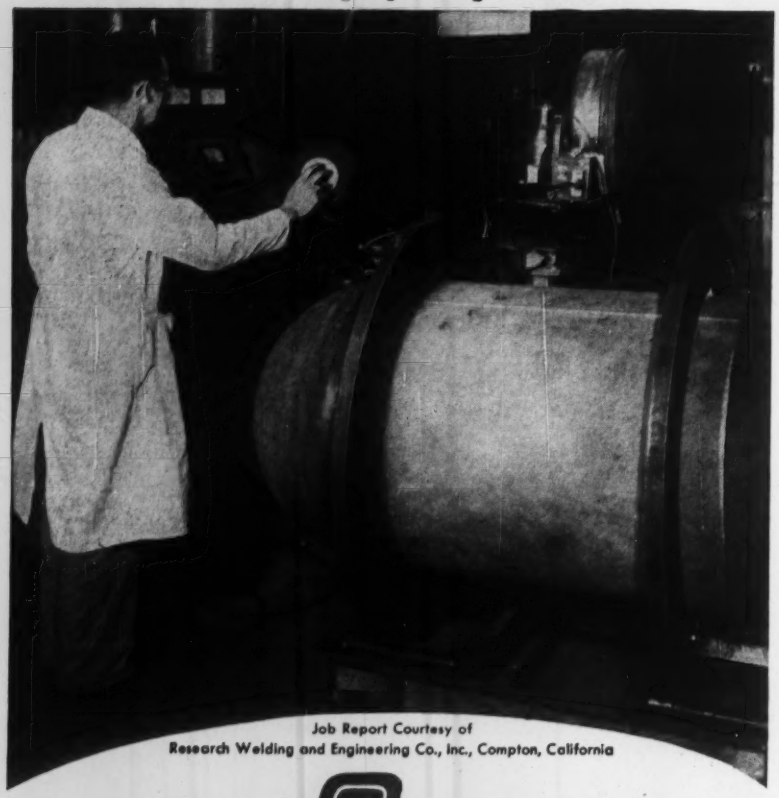
For your new drafting department, or present one, why not get the table that gets more work done? It will pay you to talk Auto-Shift with your Hamilton dealer.

Hamilton
drafting equipment

And Auto-Shift puts more draftsmen to work in available space. Designed for row installations, there's a reference desk behind each draftsman. Six men work where four do now!

HAMILTON MANUFACTURING COMPANY • TWO RIVERS, WISCONSIN

Weld from one side only . . .
Get X-ray quality welds

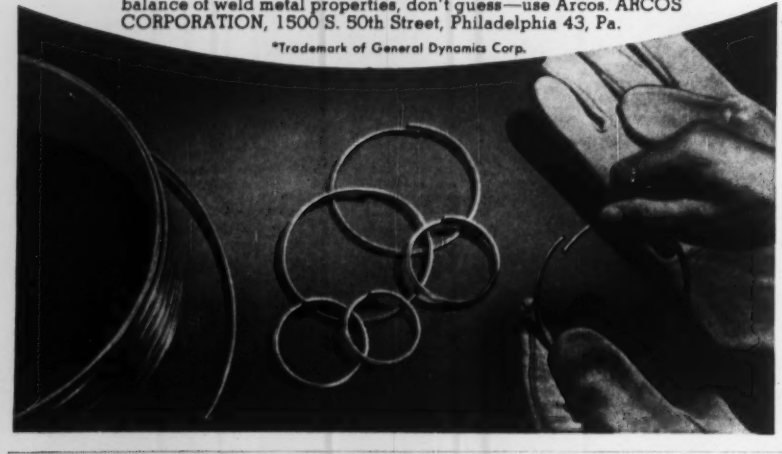


Job Report Courtesy of
Research Welding and Engineering Co., Inc., Compton, California

USE THE ARCOS EB* WELD INSERT

This welded missile tank had to weigh less than 600 pounds and yet contain air under pressure of 3,000 p.s.i. Arcos EB* Consumable Weld Inserts were used in automatic inert gas arc welding of the dished heads to the tank body. The inserts saved weight by eliminating back-up rings. They also allowed welding to be done conveniently from one side only and produced 100% x-ray quality root passes. Chromenar CMV coiled wire for submerged arc welding was used to complete the welds. After heat treatment the welds matched the base metal, with tensile strength in excess of 200,000 pounds p.s.i. Whenever your job requires a proper balance of weld metal properties, don't guess—use Arcos. ARCOS CORPORATION, 1500 S. 50th Street, Philadelphia 43, Pa.

*Trademark of General Dynamics Corp.



KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Silicone Blanket

Hewitt-Robins, Inc., Stamford, Conn., announces it has developed a silicone blanket 6-ft wide and 30 ft long for use in the high temperature vacuum bonding of epoxy resins in the aircraft industry.

This is the largest one piece unsupported silicone blanket ever manufactured according to the company. It will permit the bonding of larger airplane surfaces than was heretofore possible, it is stated.

The blankets are made in standard thicknesses of $^{1}/_{16}$ and $^{5}/_{16}$ in. but can be made in heavier gages on special order. The blankets will withstand operating temperatures up to 500 F and have good heat aging properties, high tear resistance, high elongation, high tensile characteristics, and good recovery, the firm reports.

Flexible Cushion Coupling

Para-flex, described as a wholly new concept in flexible couplings, is announced by the Dodge Mfg. Corp., Mishawaka, Ind., as the latest addition to its line of power transmission machinery.

The ability to handle angular mis-alignment, parallel mis-alignment and end-float, and in any combination, is only one of many advantages claimed for the coupling. The flexible member also cushions shock loads and diminishes torsional vibration, thus protecting both the driver and the driven machine, the company states.

Heart of the coupling is a tire with synthetic tension members bonded together in rubber. The four-way flexing body of the coupling is said to outperform the most complex coupling mechanisms, yet operate with the simplicity and dependability of a modern tire.

The coupling consists of the flexible tire clamped between two hubs which are mounted on the shafts to be coupled. The flexible member is held between the flanges and clamp rings of the hubs.

Both hubs of the coupling are machined to take Taper-Lock bushings. According to the company, these give the equivalent of a shrunk-on fit on the shaft and permit application to shafts of different diameters without reboring.

The tire has a transverse split molded into it designed to permit easy installation and make replacement possible without moving driver or driven machine.

According to the firm, the coupling will take angular mis-alignment up to 4 deg, parallel mis-alignment up to $^{1}/_{8}$ in., and end-float up to $^{5}/_{16}$ in.-contingent upon the size of the coupling and the duration of the conditions—or it will take all of these simultaneously. The resilience of the flexible member cushions shocks, smoothes out the load for both driver and driven machine. Torsional vibration developed by internal combustion engines, the amplitude of which increases greatly at critical points in the speed range, is absorbed to a great degree, the firm states.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Lead Anode Design

Facilities for design and fabrication of special or conforming lead anodes are announced by Heil Process Equipment Corp., 12901 Elmwood Ave., Cleveland 11, Ohio.

Designed for use in chromium plating, anodizing, electropickling, electrogalvanizing, and lead or lead alloy plating, these special anodes are supplied in all sizes or shapes of any lead alloy desired, the company states. The special designs complement the firm's standard styles of flat, sawtooth, round and herringbone anodes.

Miniature Diaphragm Seals

A line of miniature diaphragm seals, having cylinder bore diameters of from 1/2 to 1 in., has been announced by Bellofram Corp., Burlington, Mass.

Acting as both bellows and constant area diaphragms, the miniature piston seals function efficiently even in assemblies which are not perfectly aligned or machined, the firm claims. The seal's flange operates as a gasket, sealing mating surfaces in cylinders of two-piece design.

Standard miniature seals are obtainable having cylinder bores of .94, .87, .81, .75, .69, .62, .50.

Electric Unit Ventilator

An electric unit ventilator expecially designed for school classrooms has been introduced by American Air Filter Co., Inc., Louisville 8, Ky. The new Herman Nelson electric unit uses an electric heating coil and the firm's Draft Stop system of classroom cooling, heating and ventilating. According to the firm the unit has been tested extensively in varying climates on the West Coast, and has been found to consume from 1.3 kwh to 30.0 kwh, depending on the heat load required to keep the individual classroom comfortable.

Nut-Lock Washer

Spin-Lock nuts, said to combine the function of nut and lock washer in one piece, are available from Russell, Burdsall & Ward Bolt and Nut Co., Port Chester, N. Y.

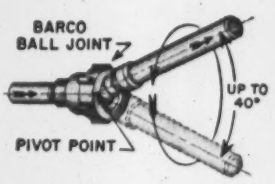
Available in sizes ranging from number 8 to 12 in., the nut provides a fastener of superior holding power while cutting assembly, purchasing and inventory costs, the company claims.

The ratchet-like structure on the base of the nut bites into the bearing surface of the metal to be joined. Torque required to loosen the nut is actually greater than the tightening torque, the company reports.

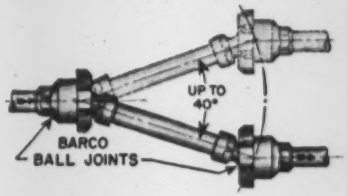
According to the firm, the one-piece fastener can be assembled in a fraction of the time required for the conventional nut and lock washer, it need not be adjusted or positioned and the teeth provide excellent contact for electric equipment.

How Barco Ball Joints Solve Piping Flexibility Problems

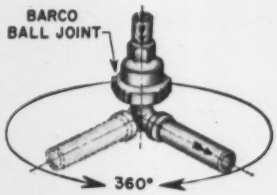
FOR TEMPERATURES UP TO 1000° TO 1200°F.



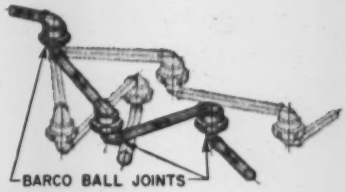
ONE JOINT—Provides for angular motion or positioning of piping in any plane. (Also see below.)



TWO JOINTS—This arrangement provides for piping alignment or simple flexible connection.



ONE JOINT—Allows for full 360° swivel or swing motion, in addition to angular movement shown above.



THREE (OR MORE) JOINTS—For complete flexibility. Any angle! Any radius! Any plane! Many arrangements possible.

In Power, Process, and Heating Service

CERTAIN distinctive characteristics and features make Barco Flexible Ball Joints particularly well-suited for solving many present-day power plant piping design problems, especially for *Steam Service:*

1. **Ability to handle compound movement (where twisting is combined with thermal expansion and contraction).**
2. **Virtually no deterioration. Able to stay in service for years without repairs or maintenance. No lubrication.**
3. **No heavy pipe anchoring required. No "end thrust" developed under pressure.**
4. **Maximum safety for high temperature applications. All-metal construction. Special metals can be specified.**
5. **Basic design is pressure sealing against leakage and self-adjusting for wear.**
6. **Easy to engineer joints into piping to provide for any degree of flexibility, expansion, or movement required.**

GET THE FACTS— New Catalog 2158 is an interesting, illustrated handbook on the application of Barco Flexible Ball Joints. Send for your copy NOW.

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PRODUCTS BACKED BY EXPERIENCE

BARCO
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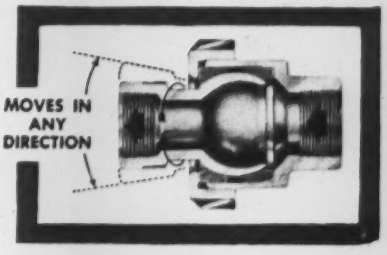
521H NORTH HOUGH STREET
BARRINGTON, ILLINOIS



Transient Converter

Fischer & Porter Co., 950 Jacksonville Rd., Hatboro, Pa., announces development of a transient converter for use with turbine type flowmeters.

The converter accepts a sinusoidal type input signal of varying frequency and provides either an analog output for recorders and oscillographs or a digital output to counters and computers.

Input frequency range for the new unit is from 0 to 600 cycles per second, operating from a 500 ohm source impedance. The output is a 0 to 100 millivolt analog signal or a 10 volt positive pulse (at 8 times the input frequency) to digital devices.

The unit has a short term analog accuracy and linearity of ±0.5 per cent and a long term accuracy of ±3 per cent. Rise time is a 10 milliseconds for a 40 to 600 cps step. Accuracy of the digital output is absolute. The converter features plug-in sub-assemblies.

Power Amplifier

Amerac, Inc., Wenham, Mass., announces the design and production of the Series 411 power amplifier.

This is a cavity amplifier specifically designed to utilize the 2C39B lighthouse triode of ceramic construction, covering the range from 1250 MC to 2400 MC. The cavity features high gain (10 db to 15 db) with a minimum RF output of more than 20 w.

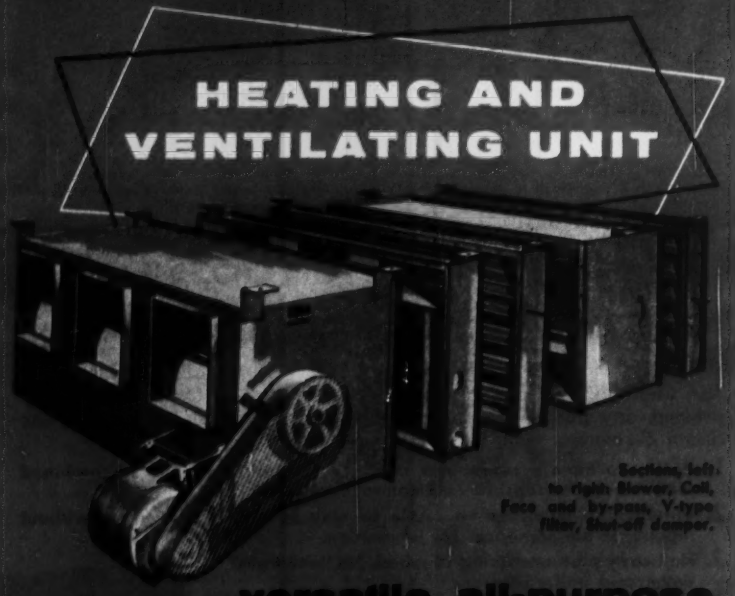
It has a resonant anode cavity with four tuning slugs, for a maximum tuning range of 100 MC. The cathode section is co-axial line, and can be adjusted by knob or screwdriver for a tuning range equal to that of the anode section. Input and output connections are 50 ohm loop couplings, with Teflon insulation on input line to minimize RF losses, the firm reports. Tube replacement is accomplished with only a 15 deg twist needed to lock or unlock. The internal socket is such that the tube is automatically guided into place and simply plugged in.

External grid biasing is provided to allow accommodation for metering grid drive. All electrical surfaces are silver and rhodium plated. External surfaces are nickel-rhodium or anodized. Aluminum alloys are used wherever possible, the company states.

Continued on Page 63

...the Make-Up AIR family proudly presents a new addition...

HEATING AND VENTILATING UNIT



Sections, left to right: Blower, Coil, Face and by-pass, V-type filter, Shut-off damper.

...versatile, all-purpose interchangeable components for Make-Up AIR and general ventilation applications...

The Make-Up AIR, using Steelfin coil, now adds to its family a heating and ventilating unit, using Aerofin copper coil. All sections are individually supported, have external flanges, and are removable for maintenance or replacement. Nine basic blower sections are available, in any desired rotation. Write today for our bulletin 567.

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VISCOSITY OF LUBRICANTS UNDER PRESSURE

This Report reviews twelve experimental investigations made in England, Germany, Japan, Russia, and the United States on 148 lubricants comprising 25 fatty oils, 94 petroleum oils, 17 compounded oils, and 12 other lubricants. Data collected are co-ordinated by means of sixty tables in which the results originally appearing in diversified units are compared. The methods proposed for correlating viscosity-pressure characteristics of oils with properties determined at atmospheric pressures are reviewed and illustrated. Pertinent topics such as experimental work on heavily loaded bearings, lubrication calculations, and additional techniques for viscosity are covered. Conclusions and recommendations are presented. Other sections give the required computation of temperature and pressure coefficients, a bibliography of 189 items, and symbols.

1954 $5.00

(20% Discount to ASME Members)

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2	16	28	41	52R	63	73	85	102	113	127TR
3	17	29	43	53	64T	74L	87	103	115	127B
4-5	18-19	30	44	54L	65	75	89	104	116	147
6	20	31	45	55L	66	77	91	105	117	149
7	21	32	46	55R	67	78L	94	106	119	IBC
8-9	22-23	33	47	56T	69	78R	95	108	121	OBC
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3	17	29	43	53	64T	74L	87	103	115	127B
4-5	18-19	30	44	54L	65	75	89	104	116	147
6	20	31	45	55L	66	77	91	105	117	149
7	21	32	46	55R	67	78L	94	106	119	IBC
8-9	22-23	33	47	56T	69	78R	95	108	121	OBC
10-11	24	35	49	57	70	79	97	109	123	
12	25	37	50T	58	71	81	98	110	126L	

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No postage stamp necessary if mailed in the United States

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Internal Grinder

A grinding machine said to be capable of heavier stock removal and faster grinding cycles than heretofore possible has been announced by Heald Machine Co., Dept. 190, Worcester 6, Mass.

Designed with the wheelhead table inclined at an angle of 30 deg to the work, the new machine achieves solid wheel backup to take heavy wheel pressure, true table tracking, excellent swarf and coolant drainage and a superior base for mounting wheelheads, the firm says.

Cycle time can be cut by up to 50 per cent on work in the upper size ranges in both straight and taper bore grinding and in ball track grinding on work up to 3¼ in. OD.

According to the company, the inclined table design is featured in two new models of the Centri-Matic internal grinder: Model 190A for straight and taper boring, Model 1901A for ball track grinding. Both are fully automatic machines for small to medium work requiring precision internal size and finish, such as antifriction bearings, retainer rings, gear blanks, refrigerator compressor rolls, bushings and similar parts.

Compact Gear Pump

A sealed gear pump which measures only 2½ in. in diam has been developed by Bijur Lubricating Corp., 151 W. Passaic St., Rochelle Park, N. J.

Featuring a special seal, this unidirectional pump can be mounted on any machine requiring fluid circulation for lubrication or other purposes, the company reports. Designed to be driven from a rotating machine shaft either directly or through a gear or chain drive of suitable ratio, the pump is applicable to machine tools, or any other machine requiring flood lubrication over gear trains, chains or cams. It is intended for recirculation sump systems.

The special lip-style seal, located on the drive shaft, will withstand back pressures up to 20 psi, the firm states. Operational failure is said to be eliminated by a venting of pressure to the inlet of the pump by means of a pressure relief system. A built-in relief valve prevents loading the seal above rated limitations.

The pump can be mounted either on its shaft side or on the opposite face. When it is mounted on its shaft side, a concentric recess permits lining up drive shaft with pump shaft for free operating conditions, eliminating binding from misalignment.

The pump can be driven in either direction, the direction of drive determining the inlet and outlet ports. Two built-in safety valves are included as part of the basic design, one for each direction of flow.

Discharge is 50 cu cm per min at 100 rpm, and recommended speed range is 20 to 1000 rpm. The pump is capable of pumping at discharge pressure of 150 psi with approximately 80 per cent efficiency.

DRAFTING TRENDS

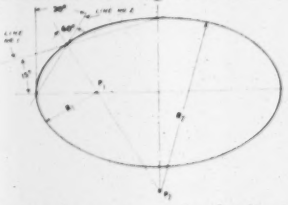
This free booklet, newly developed by the Frederick Post Company through the co-operation of leading engineers and draftsmen, shows 59 shortcuts to speed drafting and computation work.

Ideas for increasing drafting and engineering efficiency

POST went to leading engineers and draftsmen and asked them what techniques they use to save time without sacrificing precision in their work. From the many interesting tips and drafting shortcuts suggested, a total of 59 have been compiled into one handy booklet called "Time Saving Tips for the Draftsman and Engineer."

Clearly written and well illustrated, this booklet shows new approaches to old problems. The section on CALCULATING IDEAS contains 10 tips including easy ways of "Remembering the Signs of Trig Functions," "Dividing a Circle Into Parts," and "Locating Decimal Points."

One of 22 Drafting Shortcuts



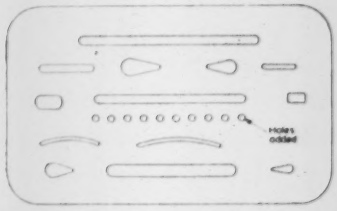
Here is what seems to be the fastest and easiest method of constructing an approximate ellipse: (1) Draw a line at 15° to major axis as shown. (2) Draw a line at 30° to minor axis as shown. (3) Draw a line at 60° to line #2 through intersection of lines #1 and #2. (4) Draw Arc R_1 from point P_1. (5) Draw Arc R_2 from point P_2.

9 tips in Engineering Data Section

Easy-to-use, practical shortcuts to formulas and other engineering data are featured in this section. Two of these time savers are faster methods of "Determining Gear Inertia" and "Interpolating Between Family of Curves."

One of 18 Board Timesavers

Fairly often when drafting it becomes necessary to change a solid line to a dotted line. By placing a series of holes in an erasing shield, as shown, it is possible to make the conversion simply by erasing through the holes.



For your free copy of "Time Saving Tips for the Draftsman and Engineer," contact your POST dealer or write today to the Reader Service Division of Frederick Post Company, 3654 N. Avondale Avenue, Chicago 18.

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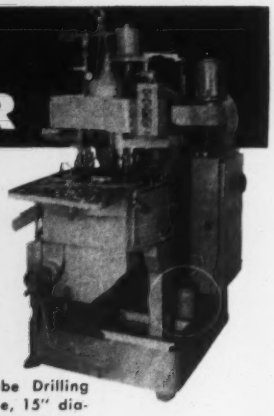

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GENERAL MOTORS CORP.
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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Microwave Absorbents

Development of absorbing materials for microwave applications, is announced by Gulton Industries, Inc., 212 Durham Ave., Metuchen, N. J.

They are designed for application where radiating microwave equipment has to be aligned or tested in restricted spaces. Of the two classes of Glennite materials, one is wide band, while the other utilizes the interference principle. According to the company, they feature low reflectivity and high absorption at centrimetric wavelength for use in darkroom and other screening purposes, and the elimination of unwanted permanent echos encountered in such areas as airfield and harbor installations.

The absorbing materials developed for S and X band frequencies, are fabricated of loaded rubber sheets bonded to brass gauze.

AF. 10 and AF. 11 absorbing materials are broad band dielectric materials intended primarily for darkroom purposes over the frequency range of 2500 to 50,000 Mc. They are obtainable in standard panel size of 12 by 12 in., and are capable of greater than 99 per cent power absorption, the firm states.

M type absorbing materials are backed with perfect reflectors. Included are types MX. 1 and MX. 3 and MS. 1 and MS. 3 materials with a power absorption of 99.5 per cent and in standard panel sizes of 2 by 3 ft.

Transistorized Computer

Packard-Bell Computer Corp,, 11766 W. Pico Blvd., Los Angeles 64, Calif., announces what it claims to be the first commercially available analog-to-digital and digital-to-analog converter that is completely transistorized.

It is called the Multiverter, and provides for voltage to digital and digital to voltage conversions at accuracies of better than .01 per cent and speeds in excess of 15,000 per second for analog to digital conversion and 300,000 per second for digital to analog conversion, the firm states.

According to the company, the unit is the most accurate converter ever produced and is the first all electronic device that permits mutliplication and division in the process of conversion.

When used to convert a number n to a voltage, the product nx may be formed simply by supplying the variable voltage x. When used to convert a voltage a to a digital number, the quotient a/v in digital form may be effected by supplying the unit with a second voltage v.

Multiverters also can be supplied which will form aw/v as a voltage where w is a third variable voltage input. When supplied either as an incremental or a whole number converter, the unit can interchange speed and accuracy so as to follow high frequency signals at reduced accuracies, the company states.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Portable Utility Fans

An improved line of portable utility fans is now being offered by Aerovent Fan Co., Inc., Piqua 42, Ohio.

The new group of all-purpose fans for industry comprises five heavy-duty units for spot cooling, drying or processing, in all types of portable or stationary applications, the company reports. These include lightweight Model 39 with cast-iron or rubber-tired wheels, portable Model 56 with column and large pedestal, stationary heavy-duty Model S, and the Steeler, said to be an exceptionally rugged portable unit designed expressly for the steel industry. These are available in sizes 24 to 48 in. The portable utility fan is offered in sizes 16 to 36 in.

The fans may be ordered with 2, 4 or 6-blade Macheta airfoil propellers, to fit their particular application. Directional air discharge of each is adjustable to 180 deg. All are of heavy-gage steel construction, with steel safety guards at front and rear.

Pressurizing Stand

High pressure, dry air or other gases for pressurizing aircraft and missile systems or for starting jet engines is said to be provided by the Model KC-1037 air stand manufactured by Kahn and Co., Inc., 541 Windsor St., Hartford 1, Conn.

A four-stage compressor delivers 15 scfm of dry air at pressures to 5000 psig. The firm's high pressure automatic dryer provides a dryness of −65 F or lower dewpoint. An ICC-3AA 6000 lb cylinder is included for gas storage.

For rocket and missile applications equipment is provided for boosting nitrogen to 5000 psig.

Stand is fully enclosed and mounted on a pneumatic tire trailer. All electrical equipment may be explosion proof if required, the company reports.

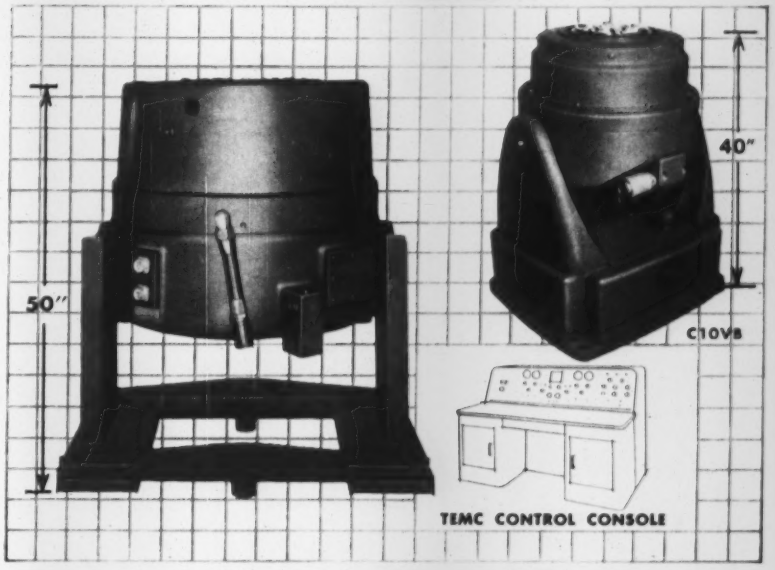
Portable Scale

A new low-priced portable scale designed for weighing heavy bulk materials at storage bins located at scattered points within a plant is announced today by Richardson Scale Co., Van Houten Ave., Clifton, N. J.

It is said to be capable of handling loads from 200 to 1000 lb. The scale is designated J-50. According to the company, to perform a simple weighing, the J-50 scale is wheeled to a storage bin loaded with a desired amount of material. It is then moved to the processing equipment, where the scale contents are discharged through clam-shell gates. Discharge may be by hand lever or air cylinder.

In weight proportioning operations, the scale is wheeled from bin to bin and desired amounts of material cumulatively weighed, one batch at a time. A large spring-dial is provided. An accuracy within 1¼ lb per 1000 lb weighings is possible, the firm states.

FIGHT VIBRATION WITH VIBRATION



Vibration Testing cuts product development time

Testing components and structures with electrodynamic vibration exciter systems cuts research and development time in aircraft and missile systems. Often within hours, or minutes, the effect of service vibration can be pinpointed.

MB has perfected shaker systems that permit testing to all required specifications, enable engineers to speed product development from blueprint to prototype to production.

COMPLEX MOTION TESTING

Several MB Exciter Systems reproduce complex and random motions. They can subject products to the actual service vibration. The Model C10VB Shaker shown offers the widest frequency range for its force. Model C25HB provides higher forces for higher "g."

ENVIRONMENTAL TESTING

Both the above shaker systems can be used with environmental chambers . . . for "high altitude" and high or low temperature vibration testing. Oil cooled, they don't affect chamber vacuum.

SPECIFICATIONS

MB C10VB System provides . . .
10 "g" on table loads to 145 lbs.
20 "g" on table loads to 57.5 lbs.

Force output:	Band width:
1750 lbs. Sine	5-5000 cps
1050 lbs. RMS	15-2000 cps
3150 lbs. Peak	15-2000 cps

MB C25HB System provides . . .
10 "g" on table loads to 422 lbs.
20 "g" on table loads to 172 lbs.

Force output:	Band width:
5000 lbs. Sine	5-2000 cps
3500 lbs. RMS	15-2000 cps
10,500 lbs. Peak	15-2000 cps

In meeting your requirements, MB offers you advanced designs . . . plus quality construction of shaker, amplifier and control system . . . plus an experienced field service organization.

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The New 82-V vacuum pumping unit "with dry sight feed," an exclusive Manzel development will end your liquid sight feed problems. Install them on any existing Manzel lubricator. Now — more accurate than ever . . . it will pay you to get complete detailed information on this dependable, field-proven Manzel unit.
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A Division of Houdaille Industries, Inc.

Overhead Crane

Atlas Industrial Corp., 849 39th St., Brooklyn, N. Y., announces the introduction of a new low head room crane. This is a complete two-ton unit which fits into a height of within 12 ft.

It is an electrical hoist with lateral mobility either hand or power operated. The overhead crane can be finished as a dolly or complete crane. It lifts up to 50 ft.

Standard Machine Bases

A line of standard machine bases said to expedite the building of machines by saving engineering time has been announced by Inter-Lakes Engineering Co., 39200 Groesbeck Highway, Mount Clemens, Mich.

The bases, which come knock-down, are made of steel plate ranging from $^{3}/_{16}$ to $^{5}/_{16}$ in. in thickness. The parts are so designed that any size of base from 24 to 48 in. in length or width and from 24 to 54 in. in height may be quickly assembled, the parts being drilled so that they can be bolted together for welding.

Circular Storage Unit

A new storage unit for no-roll parts handling in automated processing lines, has been developed by the Gear-O-Mation Div., Michigan Tool Co., 17140 E. Ten Mile Rd., East Detroit, Mich.

Designated a circular storage unit, the equipment is designed to offer a demand-feeding system from a controlled mobile-storage medium for irregularly shaped and interlocking parts that do not normally roll. Although primarily designed for parts such as spur gears, the unit can also be used for normally rolling parts, the company says.

It works on a first-in, first-out principle with no dead storage. Capacity is 600 parts using two internal levels or tiers.

Each unit is custom-tailored to a specific job and assembled from standard components. In operation, the parts are gravity fed from a collecting conveyor and enter the storage unit at a top central position. They are then chuted to the center of the upper tier where they slide onto the inner tracks. The tracks run spirally to the outer edge of the tier.

Parts motion is imparted by the independently rotating (constant rpm) tier base. Each tier handles about 300 parts and as many as the application requires (within headroom limits) can be used.

The parts leave the upper tier at the outer edge and are gravity fed to the next lower tier where the outward-from-center spiral parts movement is repeated. Exit from this tier is to a distribution system for the next operation.

Interlocked limit switches continuously sense the capacity level of parts and automatically shut the equipment off when full.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Corrosion Resistant Valves

A series of plastic Ball valves up to 3 in. in size for corrosion service, featuring full flow and positive shut-off in both directions, is available from Chemtrol Corp., 1417 W. El Segundo Blvd., Compton, Calif.

They are said to be compatible with standard fittings and piping methods, and are designed to meet the requirements of systems where corrosion problems exist from internal, external, electrical or natural corrosive elements.

The ball valves are available with female threaded ends in $\frac{1}{2}$, $\frac{3}{4}$, 1, $1\frac{1}{2}$, 2 and 3 in. nominal pipe sizes. The valve is rated at 150 psi. Depending upon material, allowable temperature is more than 200 F in continuous duty, the company states.

The valves are available in polyvinyl chloride, polyethelene and copolymer materials.

Gas-Filled O-Rings

Development of pressure-filled metal O-rings, designed to improve sealing characteristics at elevated temperatures and provide increased resilience with greater flange deflection, has been announced by Advanced Products Co., North Haven, Conn.

Standard .010 stainless steel O-rings are filled with gas at various pressures ranging from 500 to 3000 psi at room temperature. The internal gas pressure offsets the inherent loss of the metal's strength at elevated temperatures, the company states.

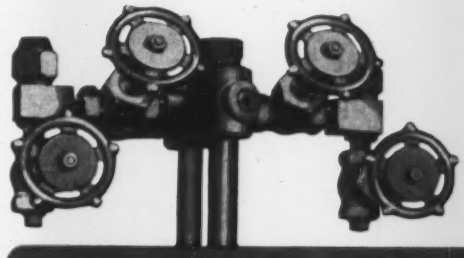
Missiles, rockets, aircraft gas turbine and other applications where operating temperatures exceed 1000 F, depending on variables of pressure and sealed material, are said to be principal uses of the new rings. Other applications include where flange faces, during the temperature cycle, separate to a distance greater than the recovery of a standard ring.

Polyester Resin

A new polyester resin, Hetron 33, is now available in limited commercial quantities from the Durez Plastics Div., Hooker Electrochemical Co., North Tonawanda, N. Y. The resin is said to be a medium viscosity, semi-rigid type polyester possessing excellent strength qualities.

It is recommended by the company for use with glass fiber where good impact strength and flexural strength are required in combination. The new product's physical properties compare favorably with Hetron 32A, which is used for such applications as matched metal die molding for automotive parts and for boats, the firm states.

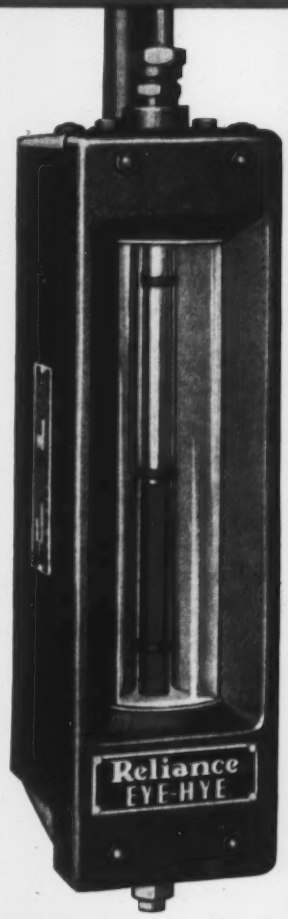
Hetron 33 is reported to be an excellent molding resin, especially for matched die molding. Laminates made from it are strong, stiff, resist impact cracking, and, in addition, are self-extinguishing. Tests made by firm prove that such laminates can be baked at 350 F for 90 minutes several times without crazing or cracking.



Models for panel or wall mounting

"Wouldn't operate my plant without them" says St. Louis engineer, of his

EYE-HYE® Remote Reading Indicators



This Reliance Gage, completely hydrostatic, assures safe, accurate reading of your boiler water levels

Here is easy natural reading (like conventional water gages) with perfect measurement and constant dependability. Twenty years on the market, and still increasing in use, here and abroad.

Simple as A-B-C, EYE-HYE indicates water level clearly by illuminated green fluid. Newly styled face plate gives wider angle of vision. And for extra safety, optional equipment adds auxiliary light signals and/or vibratory horns, reaching operators anywhere.

EYE-HYE serves main boilers — any pressure — and various power plant tanks and vessels in out-of-the-way places. Two EYE-HYEs are now acceptable under Boiler Code Case No. 1155 — eliminate maintenance of extra gage glass.

Rugged construction; no mechanical working parts; no adjustments on location; easy to maintain. Write for Bulletin CO today.

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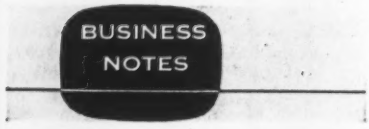
Striped Teflon Tubing

Pennsylvania Fluorocarbon Co., Inc., 1115 N. 38th St., Philadelphia 4, Pa. is offering Teflon tubing with axial stripes of any color including combinations.

The striped tubing is available in any size, and, the company reports there is no danger of wearing away the stripes since they penetrate the full depth of the tubing. According to the firm, the material has good dielectric strength (500 to 1000 v/mil.); lowest dielectric constant (2.0) and dissipation factor (0.0002) of any solid dielectric; no change of electrical properties with temperature (−100 C to +250 C) or frequency (60 cycles to 100 mc).

The striped tubing is said to be unaffected by moisture and to be suited for electronic and electrical applications since its service temperature is 250 C. Teflon is unaffected by the hot barrel of the soldering iron, the firm states.



Opens Factory Branch

Brush Electronics Co., Cleveland, Ohio, manufacturer of industrial and research instruments, has established a factory branch office at 1960 S. LaCienega Blvd., Los Angeles. Brush is a division of Clevite Corp., Cleveland.

Tanks, Processing Equipment

Graver Tank & Mfg. Co., Inc., 424 Madison Ave., New York 17, has issued a brochure marking its 100th anniversary.

Illustrated are both modern equipment and advertisements and newspaper clippings taken from the firm's historical files. A history of the company is presented.

Fastener Plant Expansion

Standard Pressed Steel Co. will build a 55,000-sq-ft addition to its main Jenkintown, Pa. plant this year, primarily to increase production of recently introduced precision fasteners. The new $750,000 building will also enable it to enlarge its research and development laboratories, the company reports.

Names Stocking Distributor

Ampco Metal, Inc., Milwaukee, Wis., has announced the appointment of E. A. Williams & Son, 325 Washington Ave., Carlstadt, N. J. as a distributor of its stock raw materials.

The new distributor will stock metal Grade 15 and Grade 18 extruded solid rounds with diameters to 5¼ in. in random and specific lengths, and Metal Grade 18 centrifugally cast semi-finished bars with 20 OD (to 10 in.) and 16 ID (to 8 in.).

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

State Representatives

Appointment of factory representatives for Illinois and Michigan has been announced by Chicago Rubber Co., Waukegan, Ill. The firm makes rubber contact wheels for abrasive belts, as well as industrial rolls, pulleys, office equipment platens, printing rolls, and molded rubber products. Frank N. Capparelli will cover Illinois from headquarters at 15 S. Austin Blvd., Chicago 44. James A. Belanger, 15620 Meadowood, Royal Oak, Mich., becomes Michigan representative.

Wire Cloth Plant

A 60,000 sq-ft manufacturing plant for the production of industrial wire cloth and wire mesh conveyors will be erected for Hewitt-Robins, Inc., at King-of-Prussia, Pa., it is announced by the company's subsidiary, Korb-Pettit Wire Fabrics and Iron Works, Inc. The new plant will provide enlarged and modernized facilities to replace those now located in Philadelphia.

New Tool Distributor

Adamas Carbide Corp., Kenilworth, N. J., has announced the appointment of Erie Industrial Supply Co., 1616 W. Eighth St., Erie, Pa., as an authorized distributor in the northwestern Pennsylvania area. It will stock the firm's line of tungsten carbide tools, tool tips, dies, wear parts, and Ceralox, a new ceramic cutting tool and wear part material.

Adhesives Plant

Plans for the construction here of a specialized plant to cost approximately $2,500,000 for the manufacture of adhesives were announced recently by B. F. Goodrich Industrial Products Co., Akron, Ohio.

The new plant, to be located on the firm's main plant property will house production facilities and a development laboratory. Approximately one hundred will be employed in the plant. Ground will be broken for the new building late this summer with completion scheduled for 1958.

Filter Sales Representatives

Four firms have been named representatives for the sale of Purolator industrial filters and two of these have also named to handle the company's line of bulk filters.

K. C. Brown Co., Kansas City, Mo. has been named representative for the sale of bulk and industrial filters in Kansas and the western half of Missouri; V. Holm Hansen Co., Bridgeport, Conn., for bulk and industrial filters in Connecticut, Westerly Township, R. I., and the counties of Hamden, Hampshire and Franklin, Mass.; Jay Besore and Assoc., San Francisco, for industrial filters in northern California and all Nevada but Clark County; Alpha Engineering Specialty Co., New York City, for industrial filters in 14 counties in New York and 12 counties in New Jersey.

Continued on Page 71

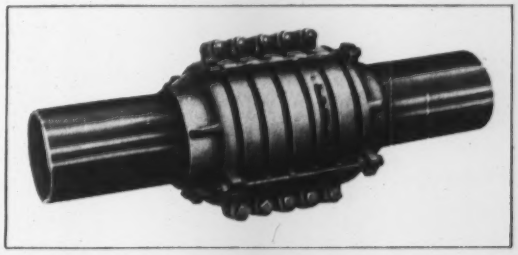
19,862 years of precision metal-forming

Time brings experience . . . experience brings skill . . . and the FLEXON® team of engineers, metallurgists, and technicians have worked a total of **19,862** years perfecting the most skillfully-made expansion joints that can be formed.

These same skills are part and parcel of all Flexonics formed and corrugated tubular shapes in metal—flexible metal hose, instrument-type bellows, "impossible" bends and section modulations for aircraft parts. They assure you expansion joints that you can **install and forget.**

Always specify FLEXON Expansion Joints—free-flexing and controlled-flexing; dual and multiple types; balanced joints and other special designs; all in stainless steel, monel, and other workable alloys. Flexon Expansion Joints last longer on the job—because they are engineered right and made better.

Write today for your copy of the Flexon Expansion Joint Design Guide—28 pages of facts about absorbing pipe motion.



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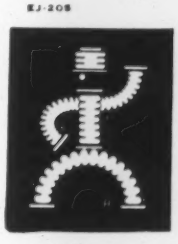

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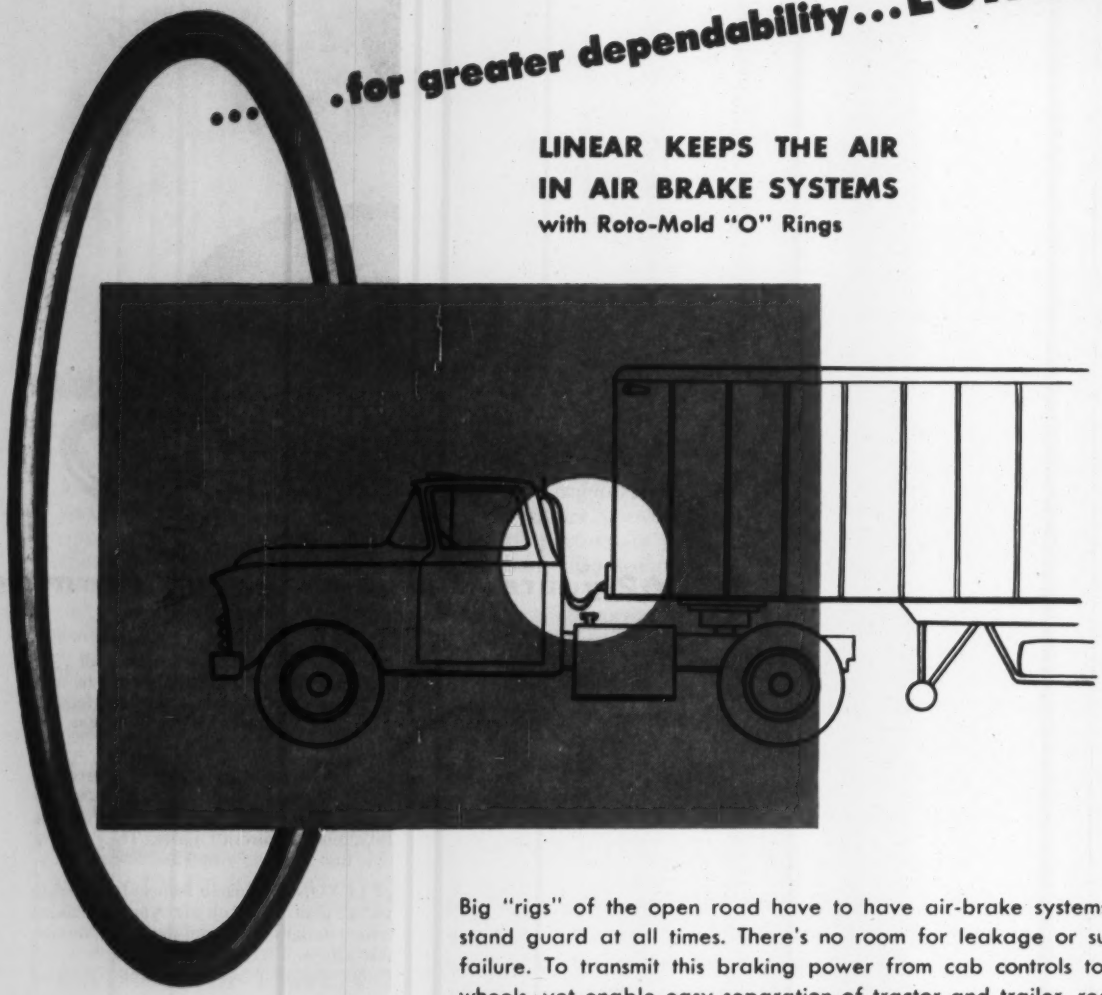
...for greater dependability...LONGER

LINEAR KEEPS THE AIR IN AIR BRAKE SYSTEMS
with Roto-Mold "O" Rings



Big "rigs" of the open road have to have air-brake systems that stand guard at all times. There's no room for leakage or sudden failure. To transmit this braking power from cab controls to rear wheels, yet enable easy separation of tractor and trailer, requires flexible hoses with quick disconnects. These coupling devices must have a positive seal, withstand braking pressure and mechanical abuse, yet connect or disconnect with ease.

LINEAR'S ability to produce precision "O" rings—fast and economically—has provided safe, positive seals for airhose couplings . . . to keep the air in air brake systems. The exclusive Roto-Mold process assures physically better seals . . . dimensionally stable . . . free from foreign inclusions and flash.

No matter what your sealing problem may be—call on LINEAR or one of its agents for engineering assistance . . . and be sure to specify LINEAR Roto-Mold "O" Rings.

"PERFECTION IN RUBBER"

LINEAR

LINEAR, Inc., STATE ROAD & LEVICK ST., PHILA. 35, PA.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Expands Facilities

New Departure Div., General Motors Corp., announces increased facilities for the manufacture of steel balls in connection with its Bristol, Conn. operations.

A recently published 12-page catalog describes the firm's ball production facilities and explains how the company, now manufacturing more than 6 million balls per day, has developed and placed in operation extensive modern machinery.

New Division Formed

A new operating divison of ACF Industries, Inc. to be called the Advanced Products Div., has been established as part of a major realignment of the company's products and plants. Manufacture of products for the petroleum, gas, chemical and nuclear energy industries—such as pressure vessels, processing equipment and tanks—will be concentrated in the new division. It also will specialize in pressed-metal items, special weldments, tank cars (except underframes), aluminum and new metals fabricated products, aircraft and missile components, ordnance products and weapons systems.

LATEST CATALOGS

Motor-Generator Welders

General Electric Co., Schenectady 5, N. Y., has issued Bulletin GEC-1453 which gives product descriptions, specifications, performance curves, and other data on the company's recently announced 300- and 400-amp motor-generator welders.

Industrial Air Compressors

A new 44-page engineering catalog, Industrial Air, has been released by the Cooper-Bessemer Corp., Mount Vernon, Ohio. It gives capacities, specifications and data on motor-driven compressors for industrial air requirements from 200 to 2000 hp.

PAST EXAMINATIONS
for Professional Engineers given by New York State

This pamphlet contains the questions given in 1952-1956 examinations. They cover problems in structural planning and design, in practical applications of basic engineering sciences, and the more advanced and specialized problems in practical applications of engineering principles and methods.

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THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
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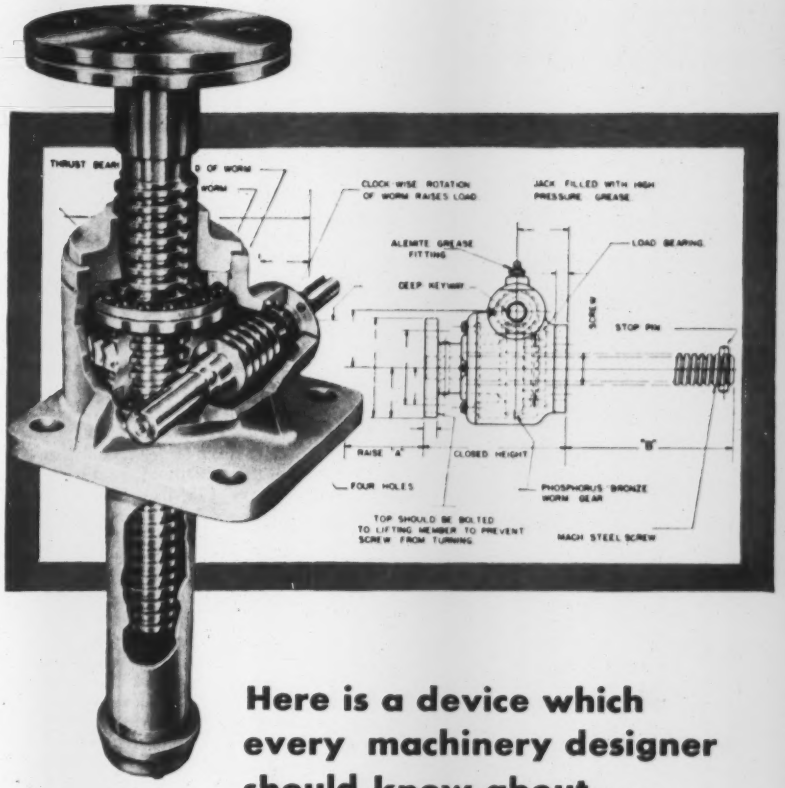

Here is a device which every machinery designer should know about . . .

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Duff-Norton worm gear jacks provide a purely mechanical means for accurate positioning of loads weighing as much as several hundred tons and maintaining them indefinitely without creep. They will operate in any position, and functioning as components of machinery and equipment they can raise and lower loads, apply pressure or resist impact. Jack capacities range from five to 50 tons. When two or more jacks are connected by means of shafting and mitre gear boxes they lift in unison, even when the load is unevenly distributed. They are available with standard raises up to 25 inches, and will provide exactly the same raise for years without adjustment. Worm gear jacks are suitable for operation at ambient temperatures up to 200°F.

Thousands of these jacks are in use on feeding tables, tube mills, welding positioners, pipe cut-off and threading machines, testing equipment, aircraft jigs, loading platforms, rolling mills, conveyor lines, arbor presses, and numerous other types of equipment. If you have a positioning problem, write for complete information, requesting bulletin AD-34-FF, which includes drawings and full specifications.

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Every manufacturer, design and production man should have this valuable data. Sent upon request.

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Power Transmission Equipment

The company's line of power transmission equipment is described in a 12-page color booklet issued by Clark Transmission Div., Jackson, Mich.

Included are illustrations of synchronized transmission series, new StepMatic transmissions, TransVerters and torque converters ranging from 11 to 26 in. in size. According to the company, foundation model of the illustrated family of synchronized transmissions is Model 265V, which has five forward and one reverse speed and is synchronized in second, third, fourth and fifth gears. This unit has a nominal torque rating of 260 lb ft and a weight of 265 lb.

Asbestos Textiles

A reference manual for selecting asbestos textiles for any application or temperature range has been published by Union Asbestos & Rubber Co., 1111 W. Perry St., Bloomington, Ill. The 16-page book is essentially non-technical. Products covered include cloth, tape, tubing, lap, roving, cord, wick, and rope; each is shown with uses and appropriate pictures. In nonmetallic and metallic cloth, there are 76 different selections.

Custom Fabrication

Specialized custom fabrication is the subject of a brochure published by the Tornqvist Co., 521 Crooks Ave., Clifton, N. J.

Many tons of customers' blueprints are processed each year by the company's engineering department as a part of its service, according to the brochure. There is a description of company facilities for working all types of metals.

Stainless Steel Sheet

A 32-page booklet on stainless steel sheet and strip is being distributed by Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22, Pa.

The booklet has more than 20 tables including data on a stainless steel finder, corrosion resistance of various stainless steels, fabrication properties, and weight tables per lineal foot in various widths and gages.

Spray Booths

Spray booths of every type, size and application are said to be featured for the first time in a single catalog, designated I-7000, available from DeVilbiss Co., Toledo 1, Ohio. Included are descriptions and specifications for custom design units and/or ready-made units which, it is said, can be erected with only a wrench and screwdriver. Information necessary to select the right type, size and features of a spray booth is included. A selector guide shows capsule descriptions of the booth, how it works and its primary uses. Each illustration is keyed to the page number and section in the succeeding pages where detailed information is available.

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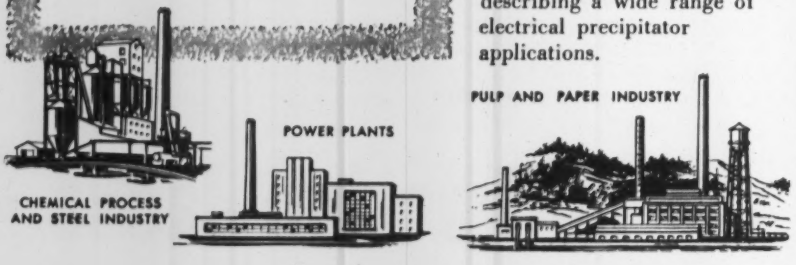

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KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Instruments, Controls

A digest of specifications of instruments and controls manufactured by the company is offered in a 12-page condensed catalog, Publication 57-687-297, by Hays Corp., Michigan City, Ind.

Diaphragm Valves

A 12-page catalog, No. 104, covering diaphragm valves has been released by Hills-McCanna Co., 2433 W. Nelson St., Chicago 18, Ill.

The catalog describes exclusive features of the firm's valves for positive closure and the latest in plastic valves and diaphragms for corrosive services are shown. A reference chart for diaphragm material selection is included, and dimensional specifications for several valve models are shown.

Stainless Steel Pipe

Trent Tube Co., Subsidiary of Crucible Steel Co. of America, East Troy, Wis., has announced the availability of a new 48-page product catalog on stainless steel and high alloy pipe and tubing.

The manual describes products ranging in size from $\frac{1}{8}$ to 40 in. OD. A series of full color photographs illustrates how the company's production and quality control procedures combine to provide a superior product for its customers.

Irrigation Meters

A 28-page brochure published by Sparling Meter Co., Inc., 225 N. Temple City Blvd., El Monte, Calif., presents more than 100 illustrations and engineering facts about modern water metering.

Advantages of metering are listed, indicating economies for both the water-distributing utility and the individual consumer. The firm's line of irrigation meters is presented with detailed cross-sectional views, specification tables, performance curves and modifications. The meters cover a range of sizes from 4 to 72 in. for use in main canals, closed conduits, turnouts, individual farm ditches and furrows.

Properties of Steam at High Pressures

This is an interim steam table covering a range from 5500 to 10,000 psi and 32 to 1600 degrees F. It is published to provide a reasonable extrapolation of the current tables that will be useful in power systems calculations until an authoritative steam table has been published—five years hence.

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Flutter Effects of Wind Tunnel Model

are recorded on

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at Bell Aircraft Corp's. Research Laboratory

On this Bell-designed multi-channel digital recorder, strain data on wind tunnel models are recorded on a *Technical* strip chart at the analog recorder, converted to a binary code, and automatically typed out by an IBM Machine.

This is but one of many research and production applications at Bell in which *Technical* Charts are depended upon for trouble-free recording. The fact that Bell can order any of over 10,000 different circular and strip charts from one source is another reason why Bell buys from *Technical*.

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For the first 9 months, 1907 was the most prosperous year the United States had experienced — and then quite suddenly, on Wednesday, October 23rd, the big Knickerbocker Trust Company of New York failed after an unexpected wave of withdrawals exhausted their supply of cash. Immediately, other banks all over the Country suffered runs and failed. People rioted in the Bronx. Industrial firms were forced to use "John Doe Checks" (checks made payable to "John Doe," meaning 'cash') to meet payrolls, and merchants and others accepted these in lieu of cash. Almost overnight the Country went from boom to bust.

In this unfavorable atmosphere, John Christensen and Soren Sorensen came to Cincinnati to start their gear business. They weathered this storm and many others in the ensuing fifty years, and today The Cincinnati Gear Company is one of the Country's leading suppliers of custom gears. In fact, we won't take a back seat to *anyone* when it comes to quality and workmanship, as our many satisfied customers will attest. Why not try us for *your* next custom gear order?

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NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Sleeve, Valve

M & H Valve and Fittings Co., Anniston, Ala., has issued Bulletin No. 20, describing its cutting-in sleeve and valve used for cutting-in extra valves for better control of flow. According to the firm, existing pipe joints need not be disturbed: cut out short section of main and insert new valve in place.

Vertical Service Pumps

Layne & Bowler, Inc., Memphis 8, Tenn., has released a six-page, five-color bulletin, No. SCP, describing short coupled vertical service pumps. It explains the uses of service pumps, including suggested installation plans, existing installations for oil refineries, pipe lines, municipal and private water works systems.

Among the advantages listed, by the company, for use of short coupled vertical pumps are lower installation costs, reduced floor space, no priming necessary, no danger of flooding and low maintenance and power costs.

Screw-Lock Bulletin

An eight-page specification bulletin, No. 738, has been issued by Heli-Coil Corp., Danbury, Conn., Div. of Topp Industries, Inc., on its line of screw-lock inserts, including the new miniature size 4-40 insert.

The bulletin contains selection tables with thread sizes, insert numbers and sizes, and information on drilling, tapping, gaging and installation. Line drawings and photographs illustrating proper installation of inserts in both blind and through holes are included, as well as basic engineering design data, military specifications, classes of fit, and assembly proportions.

Pump Selector Chart

A pump selector chart designed to aid in choosing the model, or models, best suited to their particular needs, is contained in a catalog data folder on pumps now available from Barnes Mfg. Co., Mansfield, Ohio.

The folder gives heads, capacities and other information on pumps used for jobs, including water supply, drainage, air-conditioning, pressure boosting, product and waste handling, cleaning, fire and flood control operations.

Chemical Relief Valves

Milton Roy Co., 1300 E. Mermaid Lane, Philadelphia 18, Pa. has published Bulletin No. 357 describing its line of chemical relief valves and back pressure valves. The four-page, two-color bulletin gives specifications including capacities of four standard sizes—1/4, 1/2, 3/4, and 1-in. Dimensions and materials of construction are also included.

Relief valves are used with corrosive liquids to 1500 psi, and back pressure valves are used to pressures of 200 psi. Topworks of both valves are protected by Kel-F or Teflon diaphragms.

Electromagnetic Controls

Automatic Switch Co., Florham Park, N. J. has issued Catalog 57-S, combining information in previous catalogs on the firm's line of electromagnetic controls.

High-Temperature Alloys

The physical properties, applications and shape availability of four wrought high-temperature alloys are listed in a new booklet available from Westinghouse Electric Corp. Box 2099, Pittsburgh 30, Pa.

It includes Discaloy, K42B, Refractaloy 26, and Refractaloy 70 alloys. The various Westinghouse facilities for hot forging, cold forming, machining, welding and heat treatment of these alloys are also described.

Steel Tubing Tolerances

Peter A. Frasse & Co., Inc., 17 Grand St., New York 13, N. Y., has completed a new data chart that explains tolerances for steel tubing and pipe.

Covered are tolerances for seamless and welded mechanical tubing, and seamless and welded stainless steel tubing and pipe. The chart explains each tolerance and gives the permissible variations in OD, ID, wall ovality, and straightness.

You know those rare days when *everything* checks? Air smells good. Food tastes terrific. Even the old face looks good in the mirror. *Today* can be that kind of day. Just do two things. Call your doctor for a thorough medical checkup for cancer. Then write out a check—a nice fat one — to the American Cancer Society, and send it to "Cancer" in care of your local Post Office.

AMERICAN CANCER SOCIETY

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Pneumatic Control Theory

A bulletin, No. A130, on pneumatic control instruments, featuring more than ten pages of general automatic control theory has been published by Bristol Co., Waterbury 20, Conn.

The 44-page, two-color bulletin describes and illustrates the basic concepts of narrow band, proportional, reset, derivative, and reset plus derivative control actions. Also covered are selective control, cascade control, and ratio control. Also described are the company's line of Series 500 pneumatic recording and indicating controllers, and on sensing elements used with the instruments for measuring and controlling temperature, pressure, humidity, flow, density and specific gravity, liquid level, and pH.

Fork Trucks

Engineering specifications, dimensions and mechanical features of the 5000 lb capacity gas powered model in the firm's line of fork trucks are contained in a six-page, four-color brochure now available from the Industrial Truck Div., Clark Equipment Co., Battle Creek, Mich.

Specifications include pertinent data on the engine, power train, automatic Hydratork drive, hydraulic system, upright assembly and other components. Charts and drawings indicate operating dimensions such as lifting heights, drawbar pull and turning radius. Photographs and sketches describe such features as finger-tip control levers, quick take-off counterweight, swing-up hood and self-adjusting brake.

Vacuum Gages, Barometers

A four-page catalog on its line of accurate, sensitive easy-to-read mercurial barometers and vacuum gages, vacuum pump gages and absolute pressure gages has been issued by Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia 30, Pa.

The catalog, Bulletin No. D-2, illustrates and describes mercurial barometers, mercurial vacuum gages of the central station improved type, vacuum pump gages, and an absolute pressure gage.

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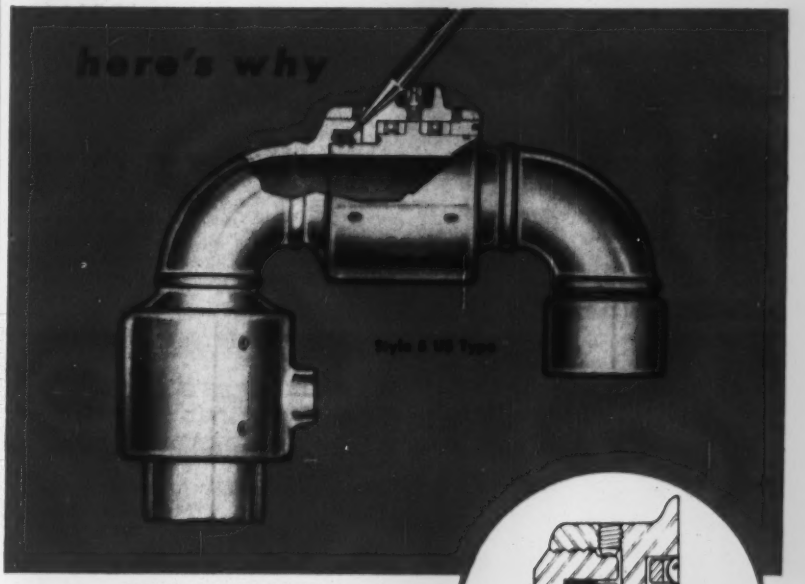

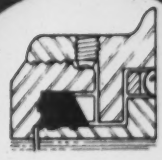

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Type US for high temperature or Corrosive Service.

UNIQUE DESIGN PERMITS EASY MAINTENANCE WHILE IN OPERATION

Three basic advantages of the Continental-Emsco Ball Bearing Swivel Joint are:

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A Continental-Emsco Swivel Joint is practically unexpendable for the reason that, after long service, both the packing and the ball races are easily adjustable and replaceable. This means no discarded joints — no costly return to the factory for repairs.

Continental-Emsco "free turning" Ball Bearing Swivel Joints are manufactured for almost every type of service, from high vacuum to pressures of 15,000 psi, and from sub-zero temperatures to 750°F. Complete information, prices and delivery upon request.

Deformable packing extruded into annular grooves assures a positive seal. This Continental-Emsco patented method minimizes the effect on torque. Any packing material such as asbestos, Blue African Asbestos, or Teflon may be used in the US Type joint.

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Forming Stock

Formica Corp. has issued a four-page bulletin describing its S-52 laminated plastics for better forming of nonferrous metals, plastics, wood, rubber, vulcanized fibers and similar ductile material. Form 604 lists all properties of S-52. Write to 4611 Spring Grove Ave., Cincinnati, Ohio.

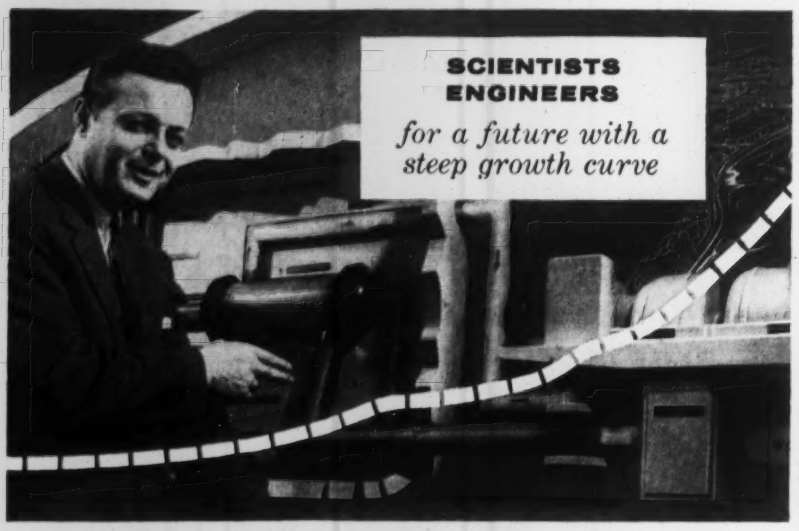
Precision Tools, Gages

A new precision tool and gage catalog has been published and is now available from Brown & Sharpe Mfg. Co., Providence, R. I.

The 96-page, illustrated catalog, designated as No. 36M, covers the company's line of precision tool and gage equipment, including several hundred new items introduced for the first time last year.

Disconnecting Switches

General Electric Co., Schenectady 5, N. Y., announces GEA-4980C, an eight-page bulletin that illustrates design advantages of the firm's new line of RF-2 disconnecting switches for sectionalizing and isolating circuits. The publication includes dimension data and ratings at which switches are designed to operate.



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WESTINGHOUSE
FIRST IN ATOMIC POWER

Wheel Dresser

Threadwell Tap & Die Co., Greenfield, Mass., has issued a four-page folder describing the new Tangi Matic dresser.

Detailed explanation of use is given, along with specifications and special features of machine that will do precision dressing of grinding wheels to any desired form faster than by conventional methods.

Specialty Strip Steels

A bulletin published by Sandvik Steel, Inc., Fair Lawn, N. J., describes service facilities and catalogs spring and specialty strip steels.

The catalog gives specific information on some of the leading types of spring and specialty strip steels. Each type is listed by application and the material, finish, usual size range and the chemical analysis in per cent is given for each. Illustrations show pure Swedish ore, sulfur-free fuel and high grade sponge iron used in making steel. The firm's sponge iron works and continuous cold rolling mills located in Sweden are also shown.

Water, Steam Hose

Two new catalog sections on its lines of water suction and steam hose have been published by B. F. Goodrich Industrial Products Co., Akron, Ohio.

The water suction hose section consists of four illustrated pages that provide operating data and specifications on five types of water suction hose for industrial use. It also provides complete coupling data. The steam hose section is a two-page illustrated leaflet that explains operating and specification data on five types of steam hose. It also includes coupling information.

"63" High Density Felts

American Felt Co., Glenville, Conn., is making available a technical data sheet, No. 19, a two-page, presentation of a new line of high density felts called Feutron 63.

The sheet describes the general characteristics of the new high density felts and diagrams their physical properties. The felts provide an opportunity for technological advances in a wide range of applications, particularly where severe mechanical operating conditions are encountered, the company states.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Processing Equipment

Pfaudler Co., Dept. ME, Rochester 3, N. Y., announces the availability of Bulletin No. 936, a buyer's guide to the firm's corrosion resistant process equipment.

Reactors, columns, heat exchangers, condensers, evaporators, storage, mixing and trailer tanks for a variety of industries are illustrated and described.

Stainless Steel Meter

Bulletin 94/10 describing a new stainless steel industrial liquid meter is available from Neptune Meter Co., 19 W. 50th St., New York 20, N. Y.

Included in the four-page bulletin are detailed cutaway illustrations, meter and register specifications, and a list of liquids that can be measured with the new meter.

Industrial Trucks

The line of industrial trucks manufactured by Baker-Raulang Co., Box 5579, Cleveland 2, Ohio is described in the company's new Bulletin 57. The 12-page, two-color illustrated bulletin also describes and pictures special attachments available for trucks.

Included are gasoline and LPG fork lift trucks in capacities from 1000 to 7000 lb; electric fork trucks in capacities from 1000 to 15,000 lb; electric platform trucks to 10,000 lb capacity; and electric crane trucks to 10,000 lb capacity. Also described is the firm's side-loading fork lift truck in a 4000-lb electric model and internal-combustion engine models from 6000 to 12,000 lb capacity.

Brass Tube Fittings

Publication of a 48-page brass tube fittings catalog is announced by Weatherhead Co., Fort Wayne Div., 128 W. Washington Blvd., Fort Wayne, Ind.

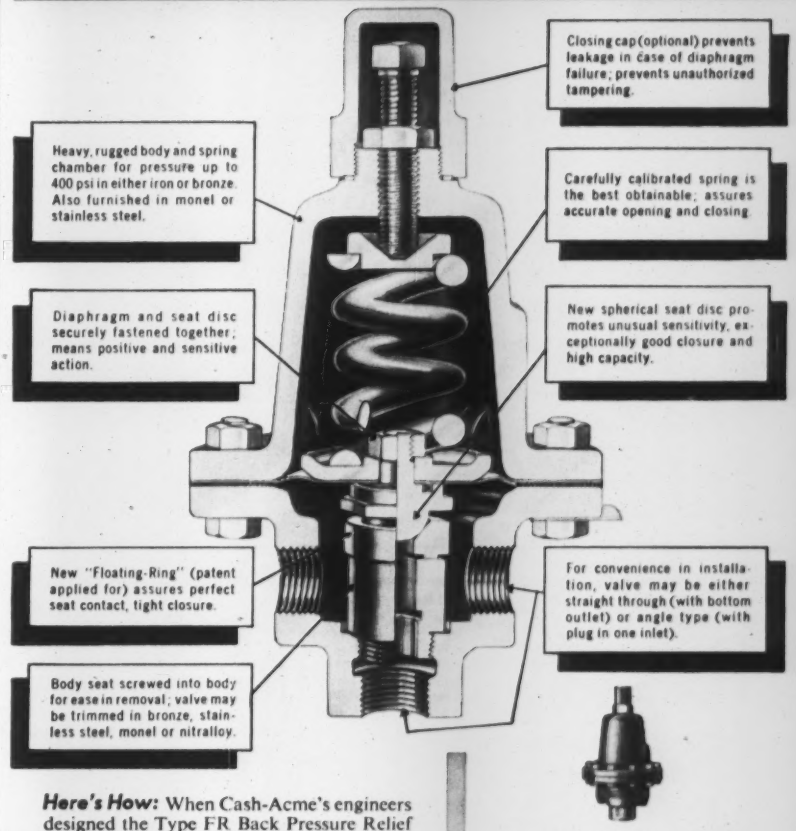
The catalog lists all sizes and types of brass fittings manufactured by the company and includes a section showing the firm's line of drain and shut-off cocks. Other subjects covered are push-pull controls, assembly instructions on all brass fittings, data on right and wrong ways for tubing a system, tube fitting data and tools.

Thermocouple Tubing

Thermocouple tubing is described in a special analysis memo No. 118, published by Superior Tube Co., 175 Germantown Ave., Norristown, Pa.

Three special analyses—Constantan, Chromel-P and Alumel—and one standard analysis—ingot iron—are covered by the memo. Special analyses are those for which there has been limited demand. Standard analyses are those for which raw materials are carried in stock at the mill. The memo gives the chemical composition, mechanical properties, physical properties, applications, production limits and standard tubing tolerances for the four materials as they relate to small tubing.

how Cash-Acme provides the Correct Answer to high back pressure valve maintenance costs


Closing cap (optional) prevents leakage in case of diaphragm failure; prevents unauthorized tampering.
Heavy, rugged body and spring chamber for pressure up to 400 psi in either iron or bronze. Also furnished in monel or stainless steel.
Carefully calibrated spring is the best obtainable; assures accurate opening and closing.
Diaphragm and seat disc securely fastened together; means positive and sensitive action.
New spherical seat disc promotes unusual sensitivity, exceptionally good closure and high capacity.
New "Floating-Ring" (patent applied for) assures perfect seat contact, tight closure.
For convenience in installation, valve may be either straight through (with bottom outlet) or angle type (with plug in one inlet).
Body seat screwed into body for ease in removal; valve may be trimmed in bronze, stainless steel, monel or nitralloy.

Here's How: When Cash-Acme's engineers designed the Type FR Back Pressure Relief Valves, they put *your* rising maintenance costs foremost in mind . . knowing that "down time" is extremely important. This superior valve series, therefore, is built to *exacting* specifications, featuring the nearest thing to *friction-free* operation as is possible to attain, which means less wearing of parts, longer life.

Do as other cost-conscious engineers and purchasing men are doing and switch to CASH-ACME.

A fact-jammed bulletin, with honest and accurate capacity charts, is available free of charge. Write today.

TYPE "FR"—Rugged Industrial Type Back Pressure Relief Valve, automatically maintains correct pressure on inlet, relieving to a lower pressure or to atmosphere. For 0 to 400 psi; ½" to 2" pipe sizes. Suitable for:

- AIR • WATER (Hot or Cold)
- GASOLINE
- OIL (Light or Heavy)
- FUEL TAR • AMMONIA
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Modified for:

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NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Check Valves

Basic check units, which can be combined with any standard pipe fitting to form a complete check valve, are described in a eight-page bulletin published by Durabla Mfg. Co., 114 Liberty St., New York 6, N. Y.

Illustrations show the unit used with a reducing bushing, 45 deg el, side outlet, drain elbow, bend and standard elbow as well as with tanks and pressure vessels. Pressure and temperature ratings are listed. Sizes and weights are given for the basic check units, vacuum breakers and reducing couplings.

Oxygen Bomb Calorimeter

Parr Instrument Co., 211 53rd St., Moline, Ill., has issued Specification No. 1200 describing its Series 1200 adiabatic type oxygen bomb calorimeter for determining thermal values of solid or liquid fuels.

According to the company, the unit is used for testing samples of coal, coke, gasoline, fuel oil, foodstuffs and other liquids or solids that can be burned in oxygen. A general description, principles of operation, operating procedures and parts and accessories are covered in the bulletin.

Packaged Air Conditioners

A 20-page two-color catalog, Bulletin 6125, covering packaged air conditioners is available from American Blower Div., American-Standard, Detroit 32, Mich.

The new catalog describes the new 1957 models in the firm's line of packaged commercial units. Design features are detailed and illustrated, and such operating components as cooling coils, fan, fan motor, compressor, condenser and controls are discussed. Physical data for the units and all major components are given for each of the models in the line.

Electric Plant Controls

Automatic Switch Co., Florham Park, N. J. announces the availability of a catalog covering its lines of solenoid operated valves, automatic transfer switches, electromagnetic controls.

New 10 and 25 amp matched lines of magnetically and mechanically held a-c and d-c relays, and the firm's standard or specialized type catalog-listed relays for nearly every requirement are featured in the new brochure.

Instrument Components

An illustrated, four-page bulletin describing facilities for prototype and production work on instrument components and assemblies has been issued by Arrow Tool Co., Inc., Box 41, Wethersfield, Conn.

The two-color publication includes a listing of all production machinery and equipment on hand at the firm's recently-expanded plant. Typical procedures in the design, tooling and assembly of instrument and business-machine components are pictured, along with a number of production operations.

Pumps, Valves

A 12-page catalog, No. 800, titled "Positive Flow Control," on covering proportioning pumps and diaphragm valves has been released by Hills-McCanna Co., 2433 W. Nelson St., Chicago 18, Ill.

The catalog describes four basic models of precision proportioning pumps for use in the range of 0–730 gph. Materials of construction, capacities and pressures are shown. Diaphragm valves for positive closure are described. Plastic valves for temperatures up to 300 F are shown.

NICE BEARINGS
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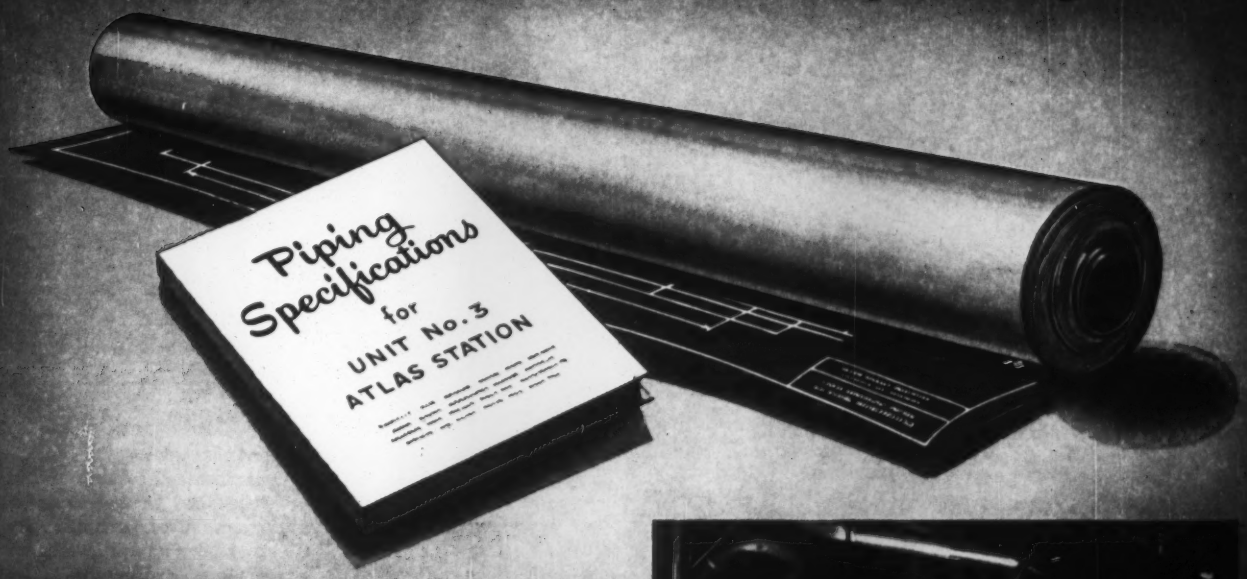

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In the fabrication and erection of every high pressure and/or high temperature piping installation, there are intangibles important to the success of the job . . . things that cannot be spelled out in the specifications but are essential to getting superior piping at an economical price.

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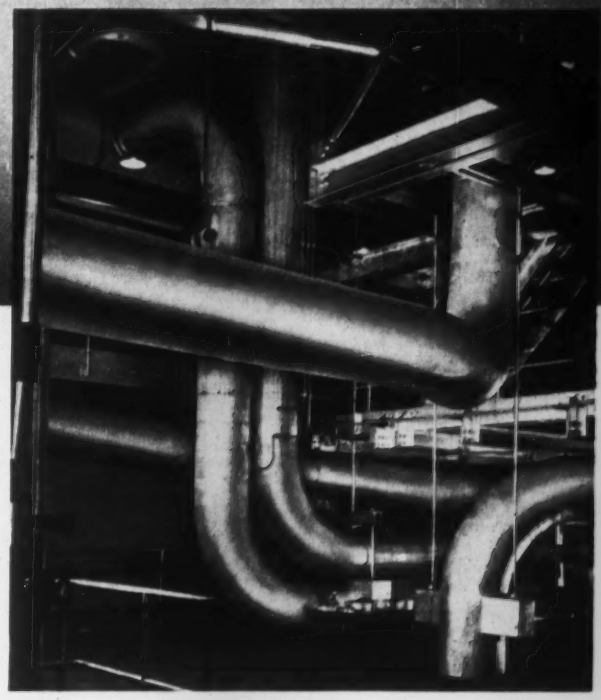
Another is a questioning attitude . . . a frame of mind that habitually asks (before the job is placed in the shop for fabrication): "Have the pre-fabricated sub-assemblies been so planned that the field work is minimized and simplified as much as possible?" Highly skilled Midwest piping engineers carefully analyze every job with this question in mind.

For power plant or process, the customer gets the most for his money when he buys Midwest Piping.



Main steam piping at Kyger Creek Plant which has a capacity of 1,075,000 kw and is the largest power plant piping contract (combining fabrication and erection) ever performed by a single contractor.

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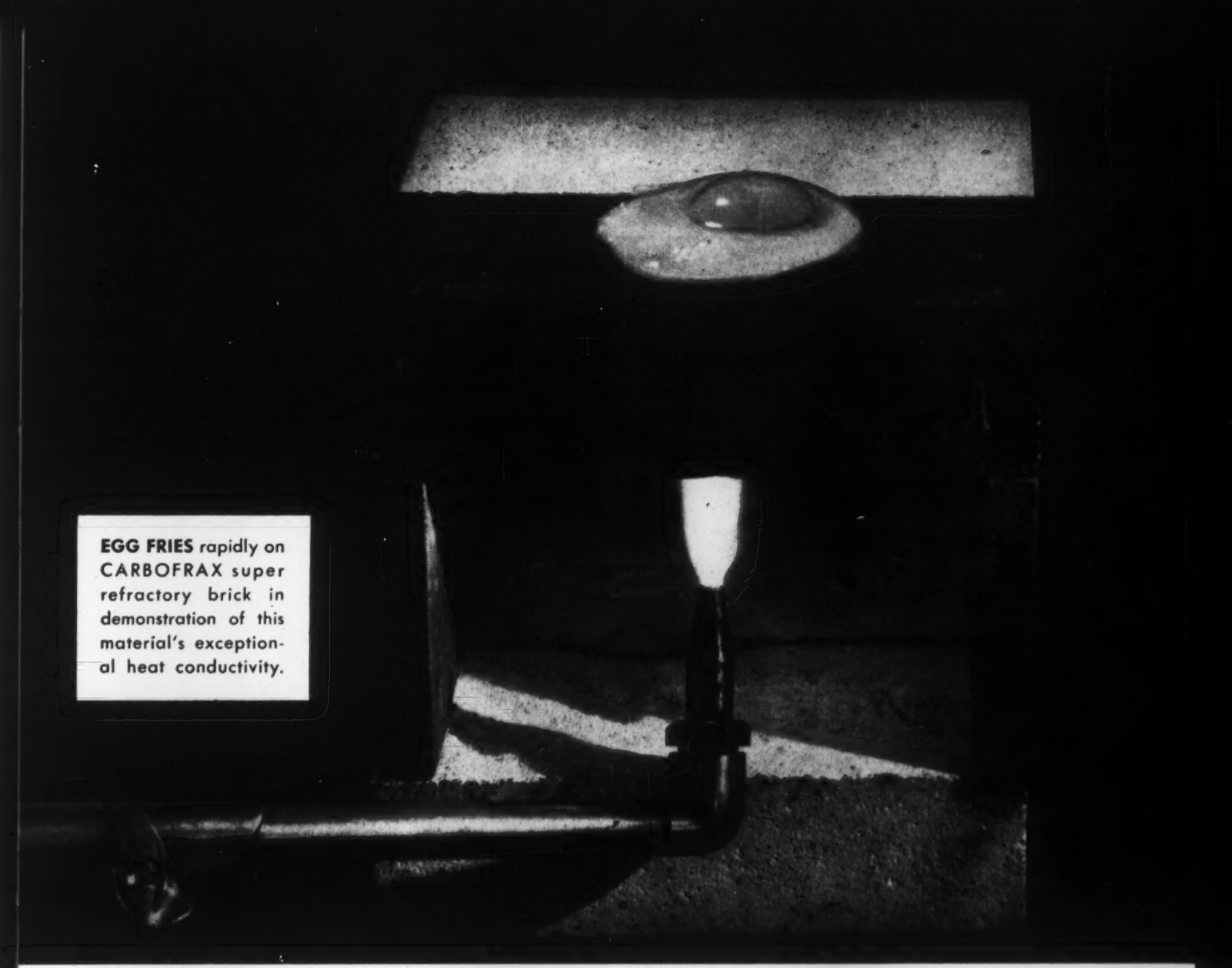

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Seldom, however, are refractories called upon to provide heat conductivity alone. They must also be able to resist corrosion, spalling, cracking, heat shock and abrasion. Ability to carry heavy loads at high temperatures is another requirement often encountered. These are but a few of the conditions successfully met by super refractories pioneered by Carborundum. Among them, you are almost certain to find answers to your refractory and high-temperature problems. For help, fill in and mail this coupon:

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A bullet for Charlemagne

THE thickset Caco general got slowly to his feet. Behind him, in the darkness, stood an ugly backdrop of a hundred Haitian outlaws. At his feet, a woman stirred a small fire.

Confronting him, the tattered young man in blackface disguise saw the fire gleam on his white silk shirt and pearl handled pistol and knew this was the murderous chieftain, Charlemagne Masena Peralte. The man he'd come for, through a jungle and a 1200-man encampment, past six hostile outposts, risking detection and certain death.

Charlemagne squinted across the fire. "Who is it?" he challenged in Creole.

There was no alternative; Marine Sergeant Herman Hanneken dropped his disguise, drew an automatic, and fired.

The night exploded into gunflame, most of it from Hanneken's second-in-command, Marine Corporal Button, and his handful of disguised Haitian gendarmes. But the shot that killed Charlemagne was the one which would finally end Caco terror and bring peace to Haiti.

Sergeant Hanneken is retired now—as Brigadier General Hanneken, USMC, with a Silver Star for Guadalcanal, a Legion of Merit for Peleliu, a Bronze Star for Cape Glöucester, a Gold Star, and a Navy Cross. And, for his incredible expedition against Charlemagne, November 1, 1919, the Medal of Honor.

The Herman Hannekens are a rare breed, it is true. Yet in all Americans there is much of the courage and character which they possess in such unusual abundance. Richer than gold, greater, even, than our material resources, it is the *living* wealth behind one of the world's soundest investments—United States Savings Bonds. It backs our country's guarantee: safety of principal up to any amount, and an assured rate of return. For real security, buy Bonds regularly, through your bank or the Payroll Savings Plan, and hold onto them!

Now Savings Bonds are better than ever! Every Series E Bond purchased since February 1, 1957, pays 3¼% interest when held to maturity. It earns higher interest in the early years than ever before, and matures in only 8 years and 11 months. Hold your *old* E Bonds, too. They earn more as they get older.

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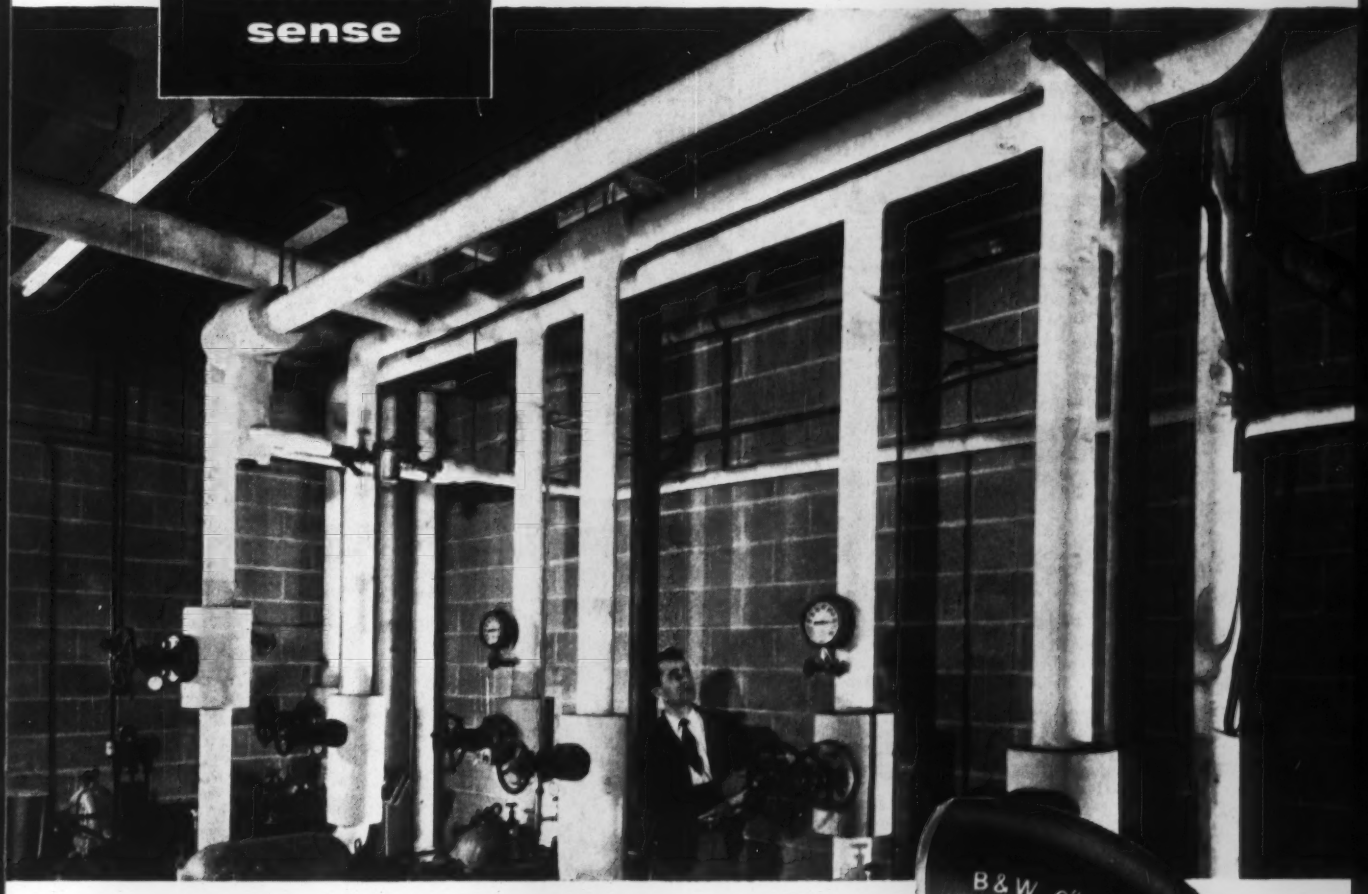
result of an engineer's good common sense

This piping installation is here to stay, thanks to B&W Seamless Welding Fittings



THE engineer who specified B&W Seamless Welding Fittings on this boiler job knew what he was doing. He realized the system would have to be permanent and leakproof for many years to come. He also realized how much time and money could be saved in fabrication, and, of course, insulation. Therefore, it was only natural that he chose welded connections since they actually become part of the piping system and are as strong, or stronger than the pipe itself. Pipes nest closer and the overall system is considerably lighter.

B&W Seamless Welding Fittings are dimensionally accurate. Full radius, true circularity and smooth walls of uniform thickness provide a smooth, fast-moving flow even under highest temperatures and pressures.

This time, specify B&W Seamless Welding Fittings and Forged Steel Flanges for a permanent and leakproof piping system. They're available in a complete range of sizes and types in alloy (B&W CROLOYS) carbon and stainless steels.

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Notice the ear phones on his head. He is in constant voice communication with the gunnite operator—receives instructions so that exactly the right proportions of water and dry castable are used. Result: longer refractory life in refinery vessel installations.

As he "guns" the castable-water mixture onto the retaining mesh, the operator talks to the man governing the mix—telling him when the mixture is coming in too wet or too dry. Prior to walky-talky communication, hand signals were given from hundreds of feet away.

Off-stream time hinges upon the durability of the equipment in the refinery. That's why Bigelow-Liptak has concentrated so much upon improvement of castable application to refinery vessels. As a result, you'll find B-L installations are hanging up record after record for long life and consequently helping to reduce the per-barrel cost of refined products. Remember that Bigelow supplies a complete one-source service to refineries: engineering, materials and erection. Better investigate today!

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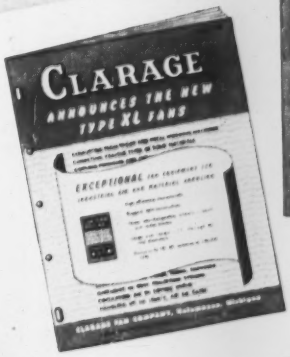

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BERNARD SIMONS, Senior Project Engineer on the Convair 880 Jetliner. A graduate of the University of Detroit, Mr. Simons joined Convair-San Diego nine years ago as an engineering designer. He is respected for his contributions to jet airliner advancement — as well as his ability to develop engineering talent.

"Engineers...here's how we combined aileron and spoiler functions in our new Convair 880 Jetliner."

"Consistent with our 34-year record of significant contribution to aircraft development, a selected group of engineers at CONVAIR-*SAN DIEGO* accepted the challenge to develop a *new* control surface concept for the Convair 880 – world's fastest jet airliner.

"Working as a team, we created a *mechanical* mixer, which combined, for the first time on any commercial aircraft, the control of ailerons and spoilers. These surfaces function as both speed brakes *and* lateral controls, and because the mixer affords direct connection to the surfaces, it gives pilots *positive* feel of the controls. Its mechanical design of bellcranks and levers permits fewer adjustments and easier, less costly maintenance to airlines operating the Convair 880.

"Important as this project is, it represents only *one* of the many creative assignments being solved at CONVAIR-*SAN DIEGO* – projects like our 880 Jetliner and F-102A Interceptor.

"You will enjoy this *diversity* of activity. You'll like the Convair atmosphere, where you see and feel accomplishment. And you will enjoy living in beautiful, smog-free San Diego.

"For greater career opportunity, for stimulating diversity – *for your future's sake* – send for more information about CONVAIR-*SAN DIEGO today!* Write Mr. H. T. Brooks, Engineering Personnel, Dept. 67-H."

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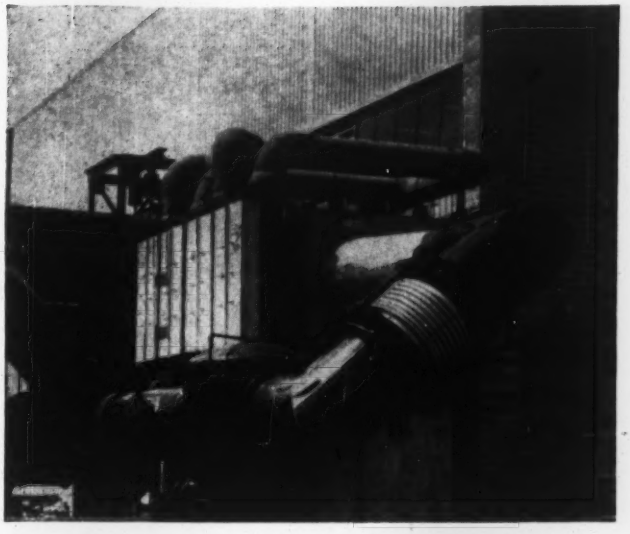


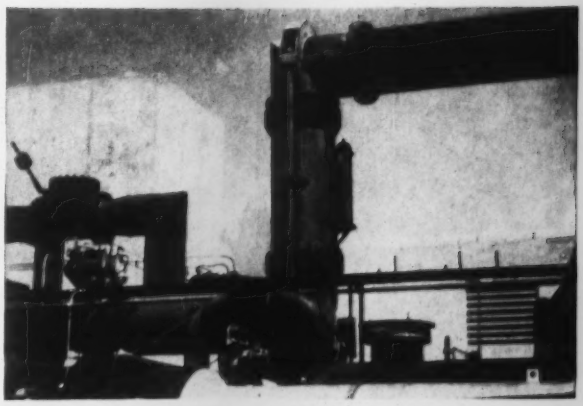
SPECIAL EXPANSION JOINTS

are Second Nature to ADSCO

These photographs show installations of special ADSCO Corruflex Expansion Joints at the Fairchild Engine Division, Fairchild Engine & Airplane Corp., Deer Park, Long Island, N. Y. All joints are designed to absorb lateral motion only, except that the long universal joint, right center, also absorbs any axial growth of its own. All joints are equipped with internal sleeves to smooth out the flow of high-temperature air being carried by the piping systems. They are not standard joints; they are specially engineered, specially manufactured.

A few years ago, when ADSCO was pioneering packless joints for special work, a job like this took considerable engineering and manufacturing time . . . because it was a new field. But since then, ADSCO has acquired so much experience from so many special orders that special jobs like the Fairchild one are truly "second nature".

Special applications of packless joints are developed carefully but not laboriously. Experience enables ADSCO engineers to get the work out easily and with confidence. Consult them next time you have a special piping problem.



REMEMBER!

Use ADSCO Expansion Joints instead of Pipe Bends because of these advantages.

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3. LESS SPACE
4. LESS COST

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YUBA MANUFACTURING COMPANY
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TO THE MEMBERS OF———

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Members of the ASME are invited to name any number of engineers as candidates for membership. Engineering acquaintances should be qualified by both fundamental training and experience for one of the technical grades. Those who do not have an engineering degree may show the equivalent thereof through actual practice. Executives of attainment in science or industry may associate with the Society as Affiliates.

THE American Society of Mechanical Engineers promotes Mechanical Engineering and the allied arts and sciences, encourages original research, fosters engineering education, advances the standards of engineering, promotes the intercourse of engineers among themselves and with allied technologists; separately and in cooperation with other engineering and technical societies, and works to broaden the usefulness of the engineering profession.

As a post graduate school of engineering, the Society brings engineers into contact with each other, with leaders of thought and with new developments; it fosters the interchange of ideas, develops professional fellowships, and encourages a high standard of professional conduct—all with the purpose of advancing civilization and increasing the well-being of mankind.

C. E. Davies, Secretary
The American Society of Mechanical Engineers
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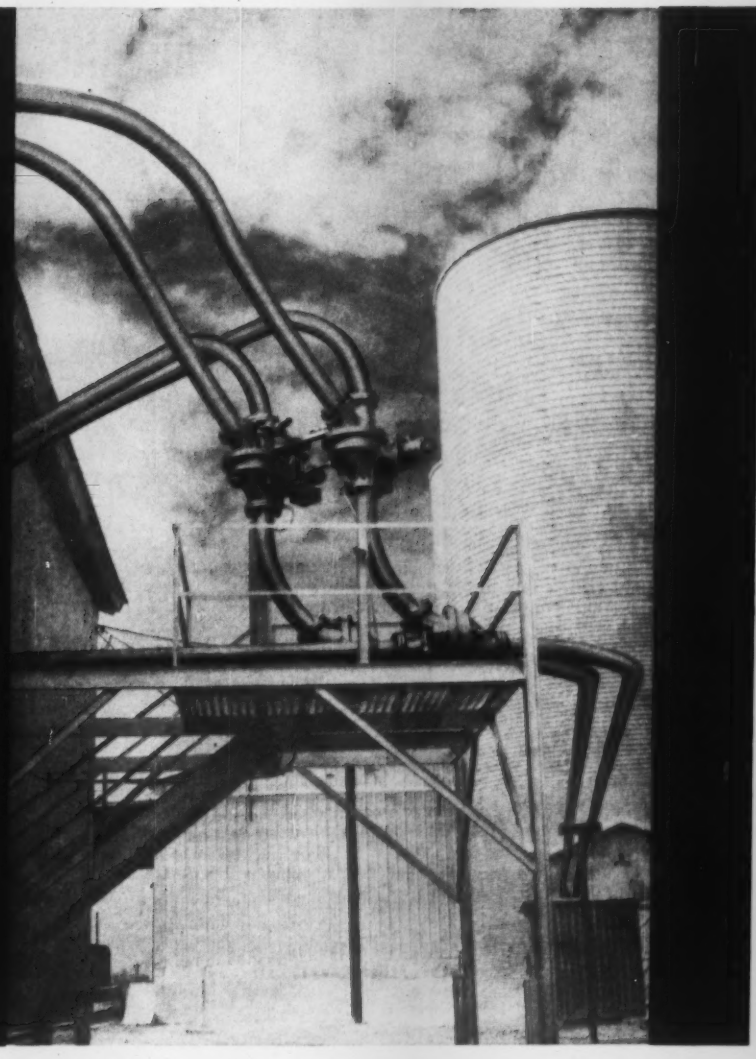
Minerals & Chemicals Corporation of America found...

It pays to specify Alcoa Aluminum Pipe to lick corrosion, prevent product contamination



When resistance to corrosion and freedom from product contamination are important, aluminum pipe is the low cost answer. Here's a case in point:

The McIntyre, Georgia, plant of Minerals & Chemicals Corporation processes Kaolin clays. Pipe originally used in corrosive stages of their process failed in as little as six months. In 1954, they specified ALCOA® Aluminum Pipe to replace it.

The natural corrosion resistance of aluminum has kept it in constant service without the heavy maintenance and replacement expense experienced before. Costly production shutdowns for pipe replacement have been eliminated. Moreover, the aluminum pipe has insured delivery of a pure, iron-free product . . . while the pipe's smooth, clean surface keeps friction loss at a minimum for low pumping costs.

Minerals & Chemicals' engineers sum up their experience this way: "Our original ALCOA Aluminum Pipe proved that it pays to specify aluminum when corrosion is a threat. Now we're using more aluminum pipe as well as aluminum siding and roofing for many of our buildings and conveying systems."

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In August, the rich fund of information brought into the 1957 NUCLEAR CONGRESS will be published in three volumes titled:

ADVANCES IN NUCLEAR ENGINEERING

HOT LABORATORY OPERATION AND MAINTENANCE

By arrangement with the publishers, you can purchase this 3-volume set from the ASME at a special pre-publication price of $35 provided your order is received by August 15th. Price after that date will be $45.

The two volumes covering Advances in Nuclear Engineering contain the 125 papers with available discussion from the 2nd Nuclear Engineering and Science Conference of the Congress.

The sixty-two of these contributions which are in Volume I are concerned with:

manufacture, production, recovery, and economics of nuclear fuels . . . spent fuel processing . . . plant containment concepts and design . . . plant components . . . waste disposal . . . protection and safety measures . . . radiation processing.

The other seventy-three articles, assigned to Volume II, deal with:

reactor design . . . reactor core design . . . operation and maintenance of reactors . . . metallurgy . . . heat transfer and heat evolution . . . educational uses of reactors . . . standardization planning in the nuclear field.

The third volume's sixty-one papers pertain to:

equipment for hot chemical, physical, mechanical, and metallurgical operations . . . hot cell installations . . . hot laboratory facilities . . . operation and administration . . . specialized hot operations.

A resume of the international outlook for atomic power, and the highlights of the 1956 meeting of the American Nuclear Society are also given.

THE 1957 NUCLEAR CONGRESS

was held in Philadelphia, Pa. last March to afford engineers and scientists in the fields of nuclear science, engineering, and management an opportunity to exchange knowledge, information, and ideas on the peaceful application of atomic energy.

Over 450 participated in discussions which explored the problems and developments of 34 specific areas of nuclear technology.

The Congress was sponsored by the following organizations with the Engineers Joint Council co-ordinating their efforts.

Amer Chem Soc • Amer Geol Inst • Amer Inst Chem Engrs • Amer Inst Elec Engrs • Amer Inst Indus Engrs • Amer Inst Mining Engrs • Amer Inst Physics • Amer Nuclear Soc • Amer Public Health Assn • Amer Rocket Soc • Amer Soc Civil Engrs • Amer Soc Engrg Educ • Amer Soc Heating and Air Conditioning Engrs • Amer Soc Mech Engrs • Amer Soc Metals • Amer Soc Testing Materials • Amer Water Works Assn • Engrg Inst of Canada • Federation of Sewage & Industrial Wastes Assns • Health Physics Soc • Hot Laboratories Committee • Inst of Aero Sciences • Inst of Radio Engrs • Nat'l Indus Conference Board • Soc Automotive Engrs • Soc Naval Arch & Marine Engrs.

In brief, this 3-volume set transmits to you a wealth of NEW information for opening new avenues for the peaceful use of atomic development. So don't wait — use this handy coupon Now to reserve YOUR set.

From the **ASME**, members of sponsoring organizations may purchase the two volumes containing Selected Papers From the 1st Nuclear Congress held December 1955 for $28, which is 20% less than charged the general public.

Volume I covers most of the field of "reactor safeguards;" reviews reactor materials, their properties, behavior, and uses; treats reactor design, components and techniques; deals with the processes of heat generation, heat transfer and fluid dynamics.

Volume II is concerned with waste disposal and radiation hazards, dissolution of solid fuel elements, the chemistry and engineering of the aqueous processing of fuel and blanket materials, pyrochemical methods, methods involving fluoride volatility differences, experimental low-power assemblies, reactor physics, instrumentation and control.

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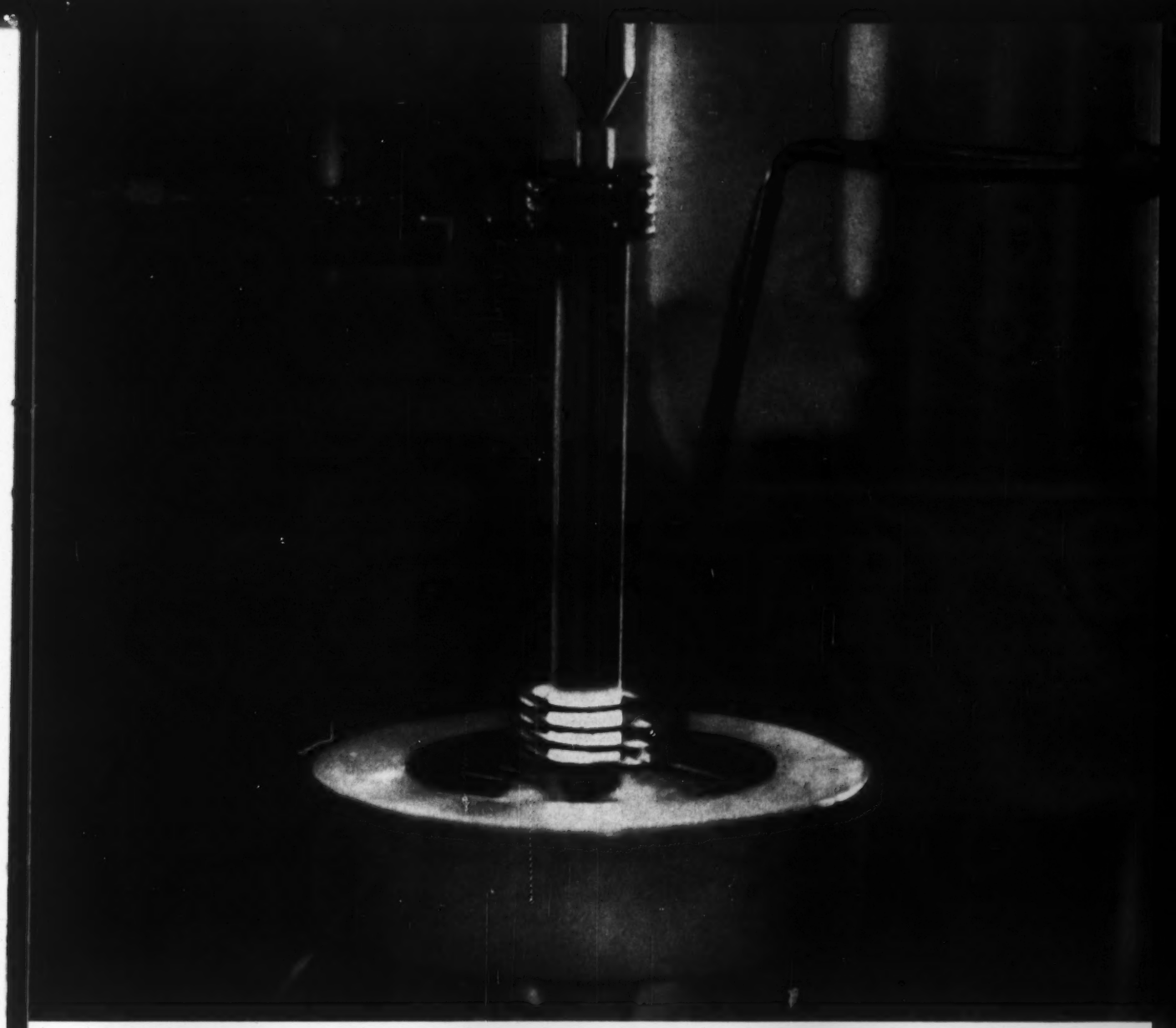

Ketos shaft being induction hardened to Rockwell 55-56, while ends remain soft for final machining. Photographed at Control Instrument Co., Inc., Brooklyn, N. Y.

KETOS has wide hardening range with minimum volume change...

Ketos is a low priced alloy tool steel that can be hardened from low temperatures with practically no volume change. It has deep hardening qualities, and a fine grained structure, that make it desirable for many production parts.

That's why nondeforming Ketos is well suited not only for most tool steel applications such as gauges, dies, and taps but also for close-tolerance, wear-resistant parts like the actuator bar shown in the induction heating unit above. The thin contact edges of this particular part withstood a "life test" of over 4-million high speed blows. No other steel tested lasted more than 1-million cycles before it chipped and failed.

If Ketos sounds like the steel you should be using, call your nearby Crucible warehouse. Stocks of Ketos and dozens of other special tool steels are large, delivery fast. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

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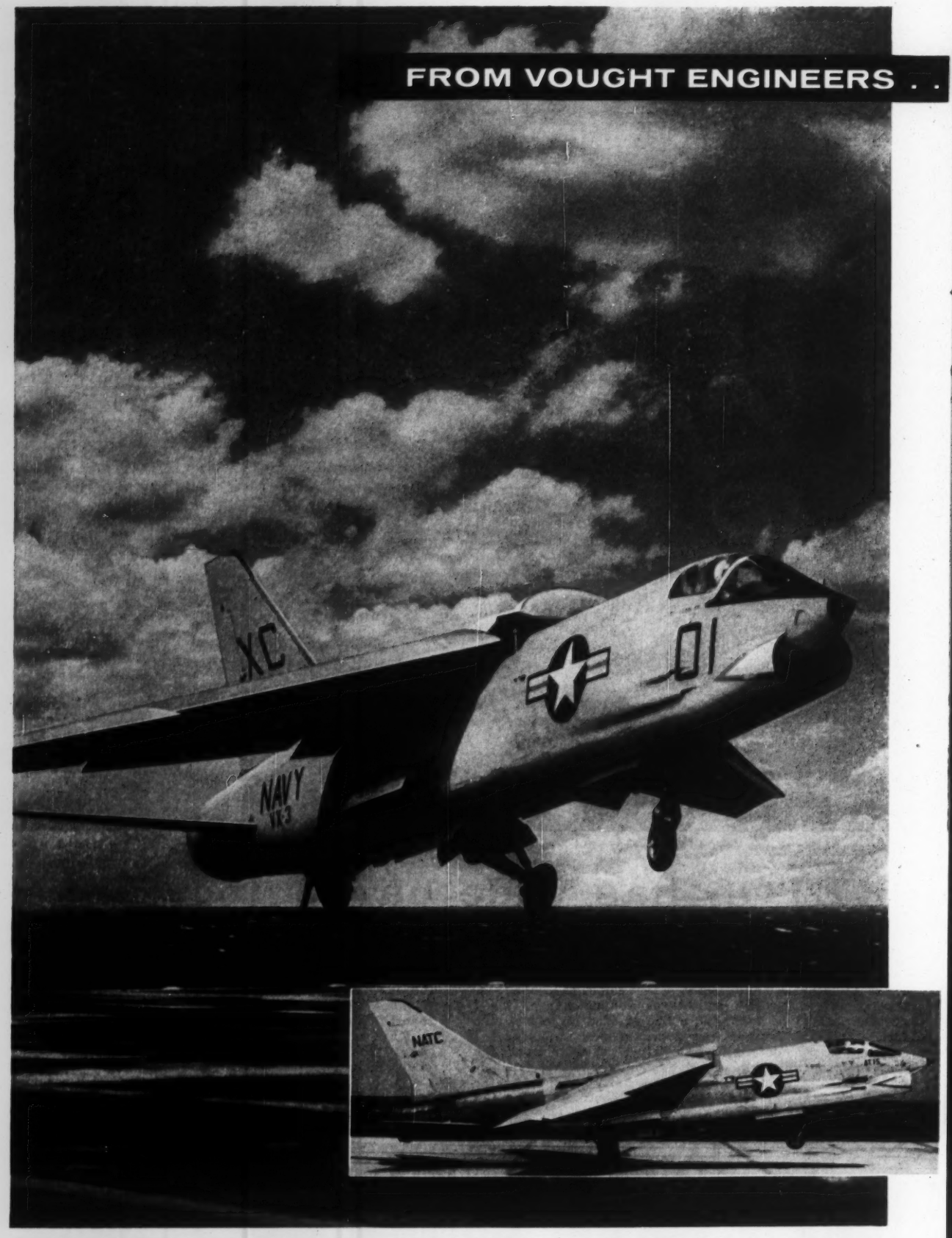
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Profile of a New Approach to a Carrier Landing

As he whistles in for a carrier landing, the Crusader pilot has the full forward visibility he so vitally needs.

Up above the cirrus, he has the slashing, 1,000-mph-plus speed that assures air superiority.

By all that governs carrier fighter design, he should be entitled only to *one or the other* of these two features. But Vought engineers conceived a variable incidence wing which enables the Crusader to give him both.

They developed a continuous wing, attached to the Crusader fuselage by pivot lugs at the trailing edge and by a hydraulic strut near the leading edge. Prior to landing, the wing may be tilted into desired approach attitude. The fuselage, meantime, remains almost horizon-level—and the pilot has a straight-on view of landing signals and the oncoming deck.

By achieving full approach visibility without elevating the pilot seat, Vought engineers have kept the Crusader canopy small, simple, sleek. This minimizes fuselage drag, and is a major factor in the Crusader's Thompson Trophy-winning speed.

Typically, the Crusader's developers approached their assignment with firsthand operations analysis, completed it with technical free-thinking. Again, they came up with an original weapon . . . and an important new concept as well.

4 IMMEDIATE OPENINGS FOR ENGINEERS

Senior Flight Test Engineer. To plan and direct flight tests of fighter and photographic-type aircraft in all phases of flight test. Requires engineering degree or equivalent, and 3 to 4 years related experience. Pilot experience applicable.

Senior Structures Design Engineer—Guided Missiles. For assignments in the structural design and stress analysis of advanced missile systems. Degree in engineering and 3 to 6 years of structural design experience.

Lead Structures Design Engineer. To assume responsibility for structural design integrity of a primary component and responsibility for structural development work. Requires engineering degree, supervisory ability and 6 to 10 years related experience.

Propulsion Engineer. For assignment in installed turbojet and rocket performance; thermal control; inlet duct and nozzle design; aerothermodynamics.

Turn tax savings into buying power

You can do it in Dallas—where there's no state income tax, no local or state sales taxes. Low school and property levies and a favorable cost of living add to your savings, or your budget for fun.

BUILDERS OF MILITARY AIRCRAFT 40th ANNIVERSARY 1917 TO 1957

CHANCE VOUGHT AIRCRAFT
INCORPORATED · DALLAS, TEXAS

To arrange for personal interview, or for a prompt report on these or other current openings, return coupon to:

Mr. C. A. Besio
Supervisor Engineering Personnel
Chance Vought Aircraft, Dept. ME-3
Dallas, Texas

I am interested in a detailed report ☐ personal interview ☐

on opening for _____

Name _____ Address _____

City _____ State _____

New Edward Instrument Valve *with integral hard-faced seat ends corrosion-erosion problems!*

Used to be, you had to choose between valves of stainless steel—which were difficult to weld into carbon steel pipelines—and valves of carbon steel, which soon corroded and began to leak around the seat. Scientists in the Research Laboratories at Edward Valves, Inc., have been hard at work on this common, costly, irritating problem. And—as usual—they have come up with the solution.

Valve seat now hard-faced with cobalt-chromium-tungsten alloy

This new Edward instrument valve combines a carbon steel body with a cobalt-chromium-tungsten seat face for long, dependable, corrosion-resistant life. *The seat is integral with the body to eliminate leak problems.* Precision machining of the alloy seat—in the same set-up as the body bore—is followed by careful lapping to form drop-tight mated seating faces with 100% bearing surface. The carbon steel body permits easy, efficient welding into carbon steel pipelines. Screwed ends are also available.

Precise flow control

Precise flow control is achieved by tapered needle point stem disk and fine pitch screw threads. This new Rockwell-built Edward instrument valve meets the need for a small, compact stop and variable flow valve for high-pressure, high-temperature service. Rated at 2500 lb. at 850F., the new valve is ideal for all power plant instrumentation. The stainless steel body line will continue in production for applications requiring extreme corrosion resistance.

For further information on the new Edward instrument valve, write for Bulletin 571.

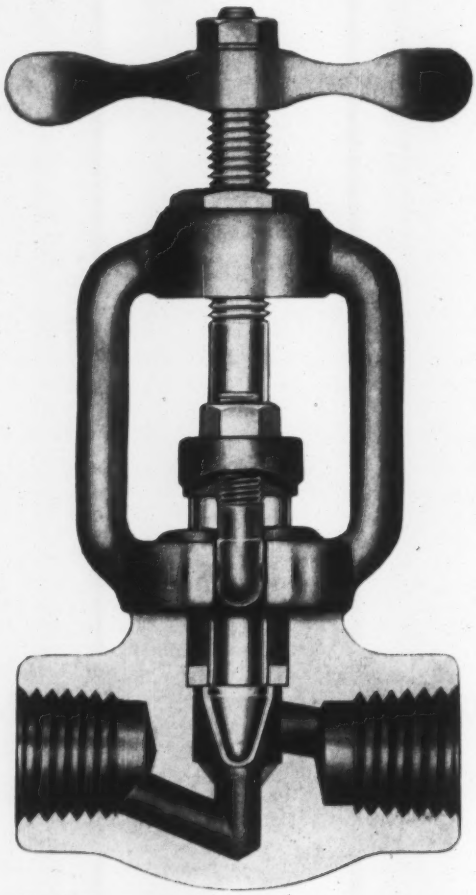
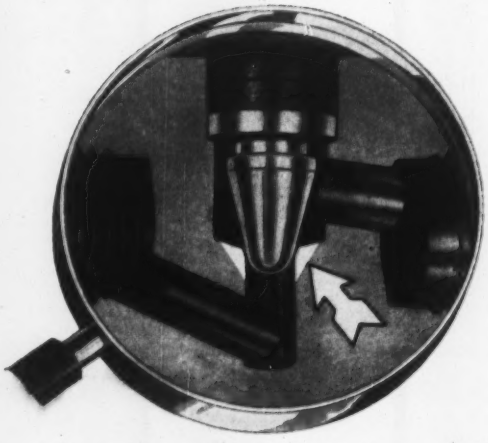


Fig. 952

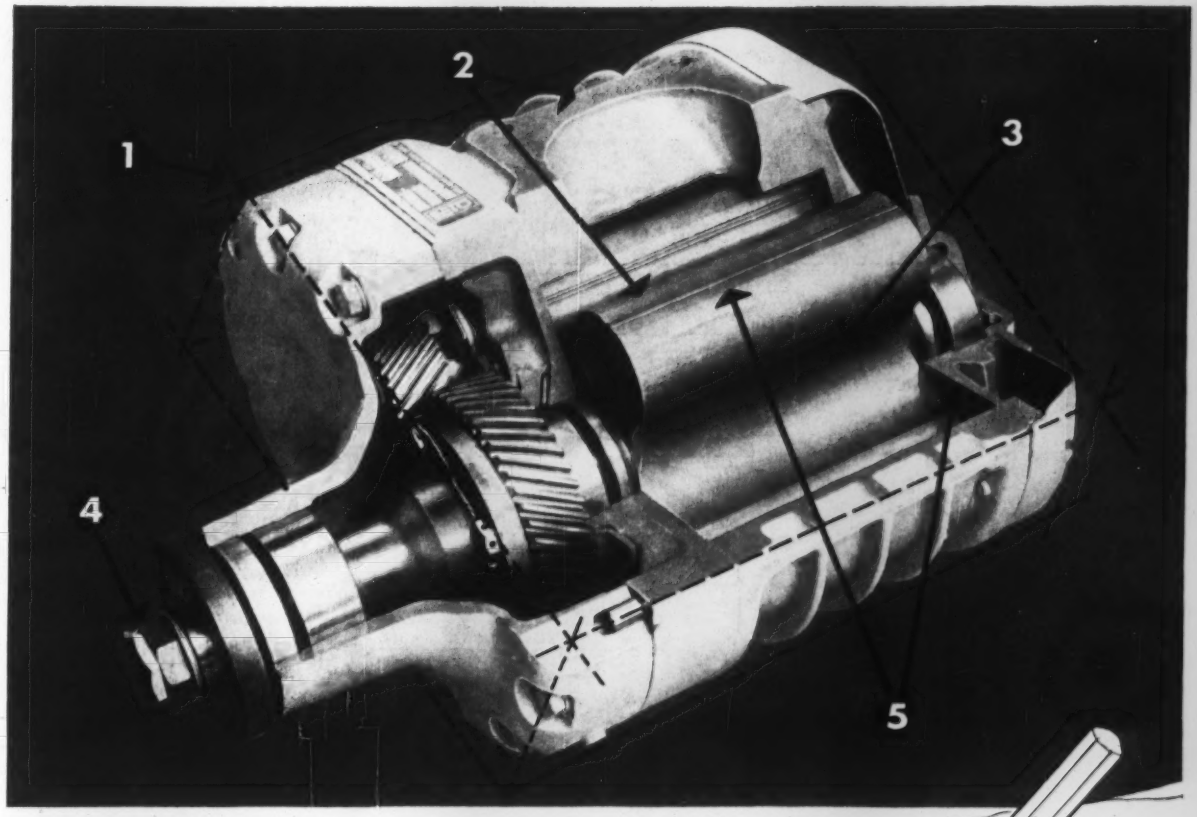


Edward Valves, Inc.

Subsidiary of

ROCKWELL MANUFACTURING COMPANY

1228 WEST 145TH STREET, EAST CHICAGO, INDIANA



The BIG difference in blowers is...

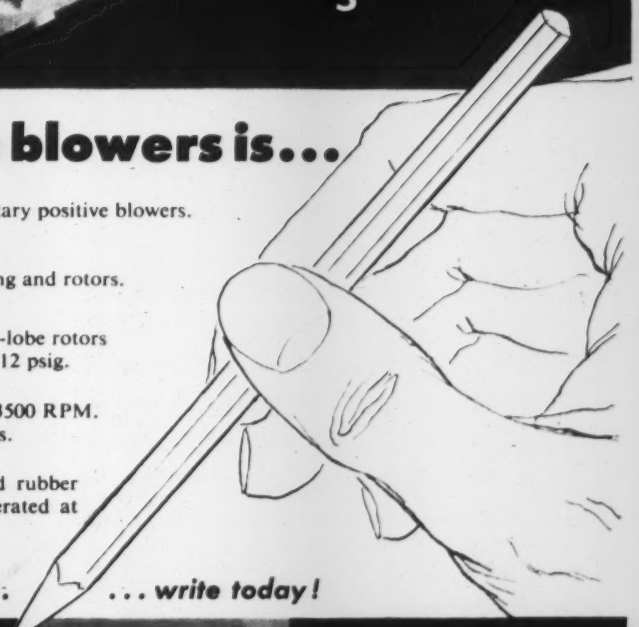
HERE 1 Smallest cube dimensions of all rotary positive blowers.

HERE 2 Lightest weight with aluminum housing and rotors.

HERE 3 Wide pressure range—exclusive 3-lobe rotors deliver pressures from 1 through 12 psig.

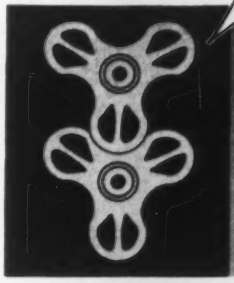
HERE 4 Direct drive at 1160, 1750 and 3500 RPM. Belt drive at intermediate speeds.

AND HERE 5 Patented formica wear strips and rubber grid seals prevent freezing if operated at excessive pressures.



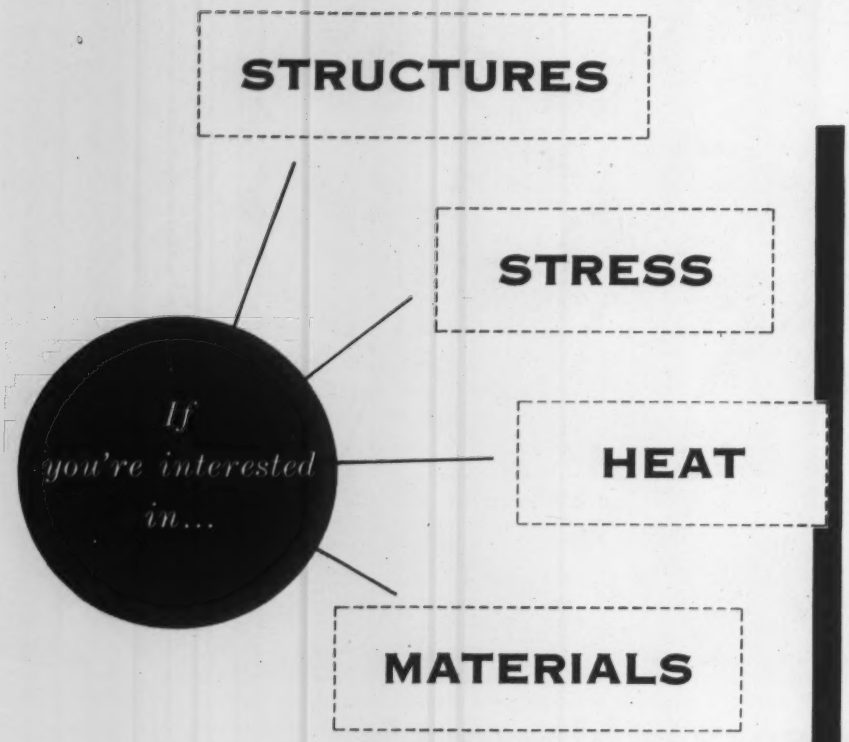
The performance figures are convincing . . . . . write today!

Miehle Dexter



Important advantages in pressure range, size, weight, cost, service!

Miehle-Dexter Supercharger Division of The Christensen Machine Company, 100 Fourth St., Racine, Wis.



there's an exceptional opportunity for you at Hughes.

There are many excellent openings for mechanical and aeronautical engineers for challenging assignments in the areas of high-speed missiles, aircraft structures, and antennas. This work concerns developing practical solutions to both theoretical and actual problems of heat transfer, structural analysis and design, stress analysis, materials section, and instrumentation.

The projects at Hughes have both military and commercial potential. Men qualified for these activities are assured of a practically unlimited future in a career with the West's leading center for advanced electronics.

You owe it to yourself to investigate this opportunity to earn a top salary while working with leading scientists and engineers in the ideal climate of Southern California. Mail us your resume to qualify for personal interviews.

Scientific Staff Relations

HUGHES

Research and Development Laboratories
HUGHES AIRCRAFT COMPANY
Culver City
California

A few of our openings include:

AERONAUTICAL ENGINEER
For aerodynamics consultation. Determination of aerodynamic loads for modifications to aircraft. Additional aeronautical engineering tasks such as stress, mechanical engineering, hydraulics, etc.

RESEARCH ENGINEER
To design and develop electro-mechanical servos and rate measuring systems for application in airborne instrumentation systems.

MECHANICAL ENGINEER
To handle the design of mechanical components related to laboratory work in the field of microwaves.

MECHANICAL ENGINEERS
To participate in the design and development of missiles, missile launchers, aircraft structure, component installation, environmental test equipment, hydraulic and general mechanical design.

AERONAUTICAL ENGINEERS
For the analysis and design of missile launching equipment for high-speed aircraft, including coordination and liaison with many major airframe manufacturers.

DYNAMICS ENGINEERS
To work on shock and vibration problems in an aerothermal environment. Also elasticians to work on advanced aerothermo-elastic problems associated with high-speed flight.

ENGINEER
For research related to the selection of materials and development of fabrication techniques.

These positions also available in the Research and Development activity at Tucson, Arizona.

VACATIONING IN SOUTHERN CALIFORNIA? YOU ARE INVITED TO VISIT HUGHES.

When piping changes direction, protect process equipment with

ZALLEA SELF EQUALIZING UNIVERSAL EXPANSION JOINTS

Zallea Self Equalizing Universal Expansion Joints absorb any movement in any direction . . . axially, laterally, angularly, or any combination of these . . . making them ideal for protecting process vessels and rotating equipment from thermal expansion of connected piping.

When there is a leg or 90° offset to a long run of pipe, one Zallea Universal Expansion Joint will frequently take care of the entire system.

Under conditions of low load requirement for anchors or equipment . . . or when compressive loading in pipe walls must be kept to a minimum . . . Zallea Universal Expansion Joints are the most economical answer to the problem. They absorb the internal pressure thrust. The piping system need only carry the relatively small deflection loads.

Many types of Zallea Tied Expansion Joints are designed especially to absorb lateral deflection or rotation when there is pressure in the line. Universal, Modified Universal, Hinged, Gimbal, Pressure Balanced and Universal Pressure Balanced Expansion Joints give you a choice of the type best suited to your particular application.

Get the complete story of Zallea Expansion Joints in our new 72-page manual. Write, on your company letterhead, for your copy of Catalog 56. Zallea Brothers, 820 Locust Street, Wilmington 99, Delaware.

Zallea
expansion joints

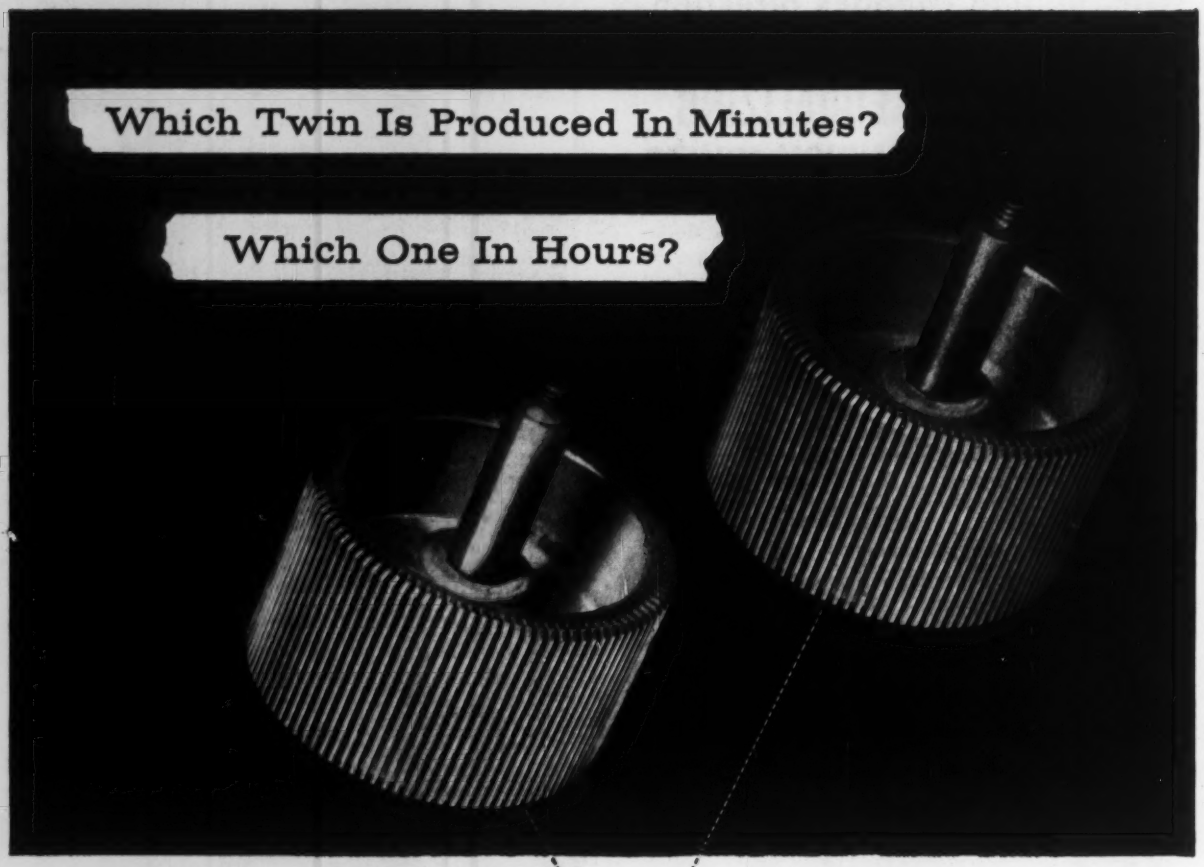
Zallea Brothers • Wilmington 99, Delaware

World's largest manufacturer of expansion joints

24" dia. Zallea Universal Self Equalizing Expansion Joints in service lines of the engine test facility of a West Coast aircraft manufacturer.

Which Twin Is Produced In Minutes?

Which One In Hours?



These parts are identical. One, however, is produced in minutes, the other in hours. Parker-engineered die casting makes the difference.

Formerly, this part (shown left above) was machined from the solid. The threaded steel shank was inserted in a separate operation. Numbers on the face (not shown) had to be stamped . . . still another operation. *Total production time per piece was measured in hours.*

Now, this same part, including the steel insert and the face numbers, is produced as a unit by Parker-engineered die casting. Trimming of gate and fins is the only secondary operation. *Total production time per piece is now measured in minutes.*

Here is just another example of the way Parker-engineered die castings save you money.

This skill and experience can solve problems—and save money—on *your* components parts. Just call the nearest Parker sales engineer or write the factory direct.

Parker White Metal Company • 2153 McKinley Ave., Erie, Pennsylvania

PARKER SALES ENGINEERS

BELLEFONTE, Penna.
Warren G. Olson • 420 East Linn Street

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PARKER

high pressure ALUMINUM and ZINC die castings
POWDERED METAL PARTS

BIG CITY • BIG DEMAND

BIG RIVER Solution: Big Pumps

Capacity 50,000,000 gallons a day

Installed for ST. LOUIS COUNTY WATER COMPANY, NORTH END PLANT, ST. LOUIS, MISSOURI

Intake Pumps: 4 - 150 hp Peerless 36" single-stage vertical turbine pumps.

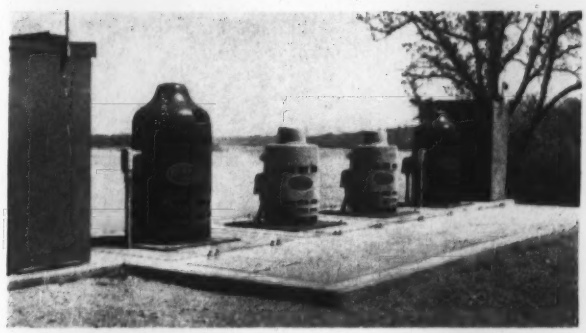
Booster Pumps: 8 - 500 hp Peerless 22" single-stage horizontal double-suction pumps.

Here's another installation that convincingly demonstrates Peerless' ability to do the complete pumping job efficiently:

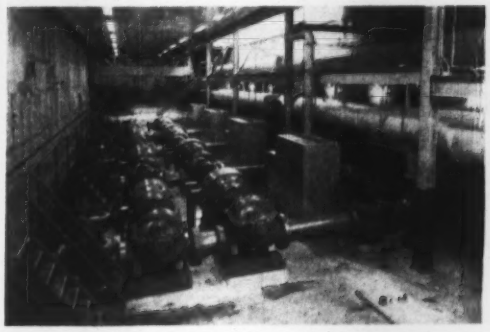
vertical pumps for **water supply**
horizontal pumps for **water pressure**

Either way you look at a pumping job—towards horizontals or towards verticals—follow the lead of consulting and water works engineers everywhere. Select Peerless horizontal and vertical pumps from one of the most complete lines of high quality, water handling pumps offered by any manufacturer.

Remember: Peerless builds dependable pumps for *all* water handling services—supplying, circulating, dewatering, drainage and flood control protection—and for all applications—municipal, industrial, commercial and domestic.



BIG VERTICALS—The middle 2 of these 36" single-stage Peerless vertical intake pumps are driven by 150 hp induction motors. The other 2 pumps (same specifications) are driven by wound rotor motors.



BIG HORIZONTALS—These 8 Peerless horizontal single-stage, double-suction pumps are driven by 500 hp motors. Mounted in series, these 22", high service pumps maintain pressure at required standard.

PEERLESS PUMPS

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
301 West Avenue 26, Los Angeles 31, Calif.

fmc

Factories: Los Angeles 31, California and Indianapolis 8, Indiana
Offices: New York; Atlanta; Chicago; St. Louis; Phoenix; San Francisco; Fresno; Los Angeles; Plainview and Lubbock, Texas; Albuquerque.
Distributors in Principal Cities. Consult your Telephone Directory.

PLEASE SEND PUMP BULLETINS DESCRIBING

☐ Peerless Horizontal Pumps (Bulletin B-1300) ☐ Peerless Vertical Pumps (Bulletin B-505)

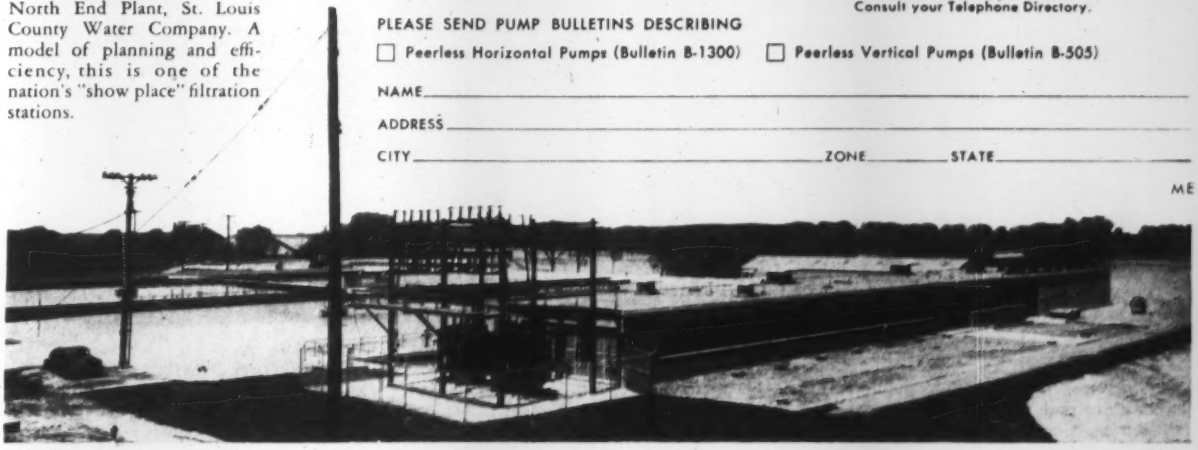
NAME_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

ME

BIG PLANT—View of the North End Plant, St. Louis County Water Company. A model of planning and efficiency, this is one of the nation's "show place" filtration stations.



Get ahead!

Check this unusual opportunity to advance... at Western Electric

Engineering careers don't get a chance to bog down at Western Electric . . . there's just too much going on to allow it.

In the course of their technical work, engineers participate in such broad managerial functions as production, merchandising, installation, and many others. What's more, we have a record of promotions from within. That's important when you realize that at least 8,000 of our people will be promoted to management jobs in the next 10 years.

Here you'd help engineer the manufacture, distribution or installation of equipment needed by the Bell System. Your responsibilities could involve radio relay equipment for TV and long distance calls, electronic switching, transistors, printed circuits, miniaturization, or automation. You'd work with top men in the communications field...in an atmosphere that's alive with the need for new products, new processes, new ideas. Your ideas would help answer the constant demand for more and better telephone service...help handle the constant flow of defense jobs that the government has asked us to take on over the years; like the Nike guided missile system, DEW Line and Sage, the continental defense system.

And you'd be given every encouragement to develop as rapidly as possible...our joint telephone-defense job demands it. A full-time Graduate Engineers Training Program is given new engineers during working hours to help them more easily assume a full engineering role. We also sponsor a tuition refund plan for out-of-hours study at nearby colleges.

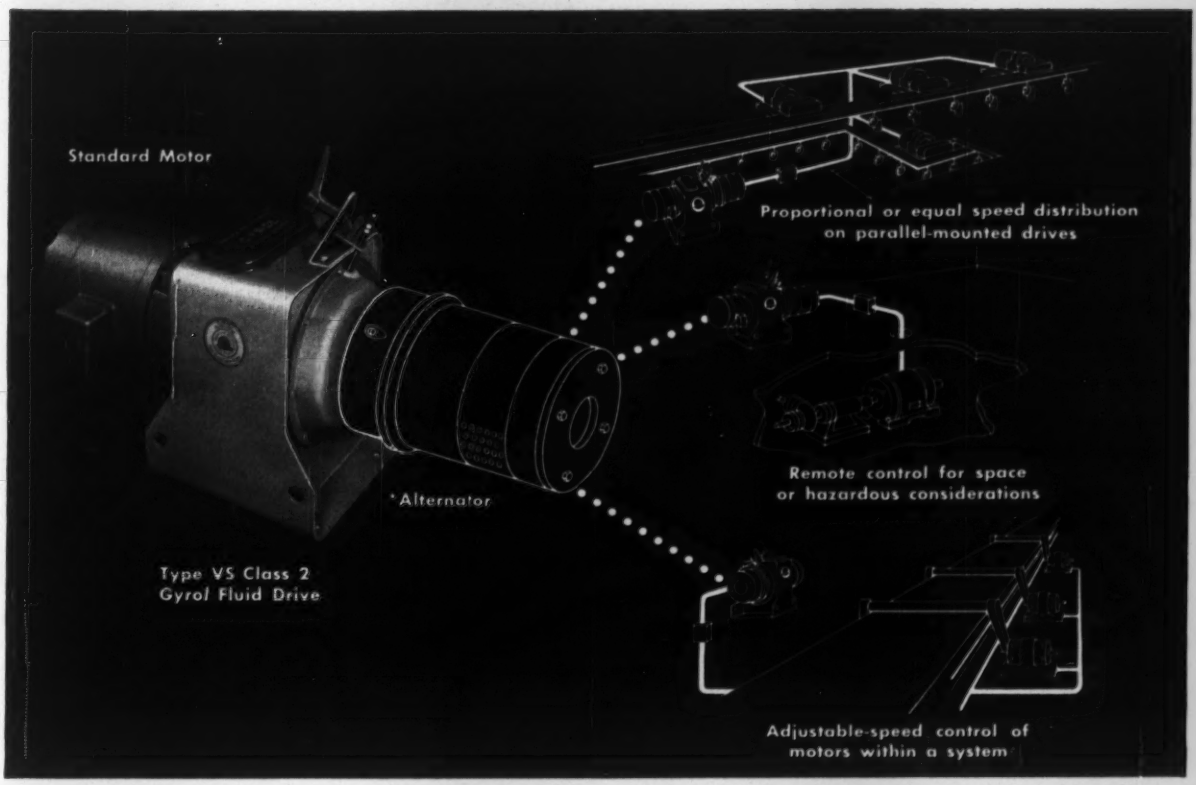
So, check the openings for which you may be qualified (mechanical, electrical, chemical and civil engineers; physicists and mathematicians). Send resume of education and experience to Engineering Personnel, Room 1063, Western Electric Co., 195 Broadway, New York 7, N. Y.

Western Electric

MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM

Manufacturing plants in Chicago, Ill.; Kearny, N. J.; Baltimore, Md.; Indianapolis, Ind.; Allentown and Laureldale, Pa.; Burlington, Greensboro and Winston-Salem, N. C.; Buffalo, N. Y.; North Andover, Mass.; Lincoln and Omaha, Neb.; St. Paul and Duluth, Minn. Distributing Centers in 30 cities and Installation headquarters in 16 cities. Also, Teletype Corporation, Chicago 14, Illinois.

AMERICAN BLOWER *Gyrol* FLUID DRIVE


Standard Motor
Proportional or equal speed distribution on parallel-mounted drives
Remote control for space or hazardous considerations
*Alternator
Type VS Class 2 Gyrol Fluid Drive
Adjustable-speed control of motors within a system

*Output adapter, flexible coupling and alternator furnished by others.

Matched, adjustable-speed control of AC induction motors lets you control speeds in coordinated production processes

Here's how it works: an alternator, driven through an adjustable-speed Gýrol Fluid Drive, makes variable frequency available from a fixed-frequency power source. Motor speeds are controlled by merely regulating the Gýrol Fluid Drive.

The Gýrol Fluid Drive method is a simplified system for controlling the speed of driven machinery. For example:

- On parallel-powered drives, the constant-speed motors are given coordinated speed adjustment thru the frequency control created by the adjustable-speed Gýrol Fluid Drive.
- The speed of two or more machines or conveyors may be controlled equally or proportionally by a single Gýrol unit coupled with an alternator.
- The Gýrol Fluid Drive's speed control enables you to adjust speeds manually, semi-automatically or automatically at a remote station.

For full information on how you can adapt Gýrol Fluid Drives to your specific requirements, call our nearest branch office.

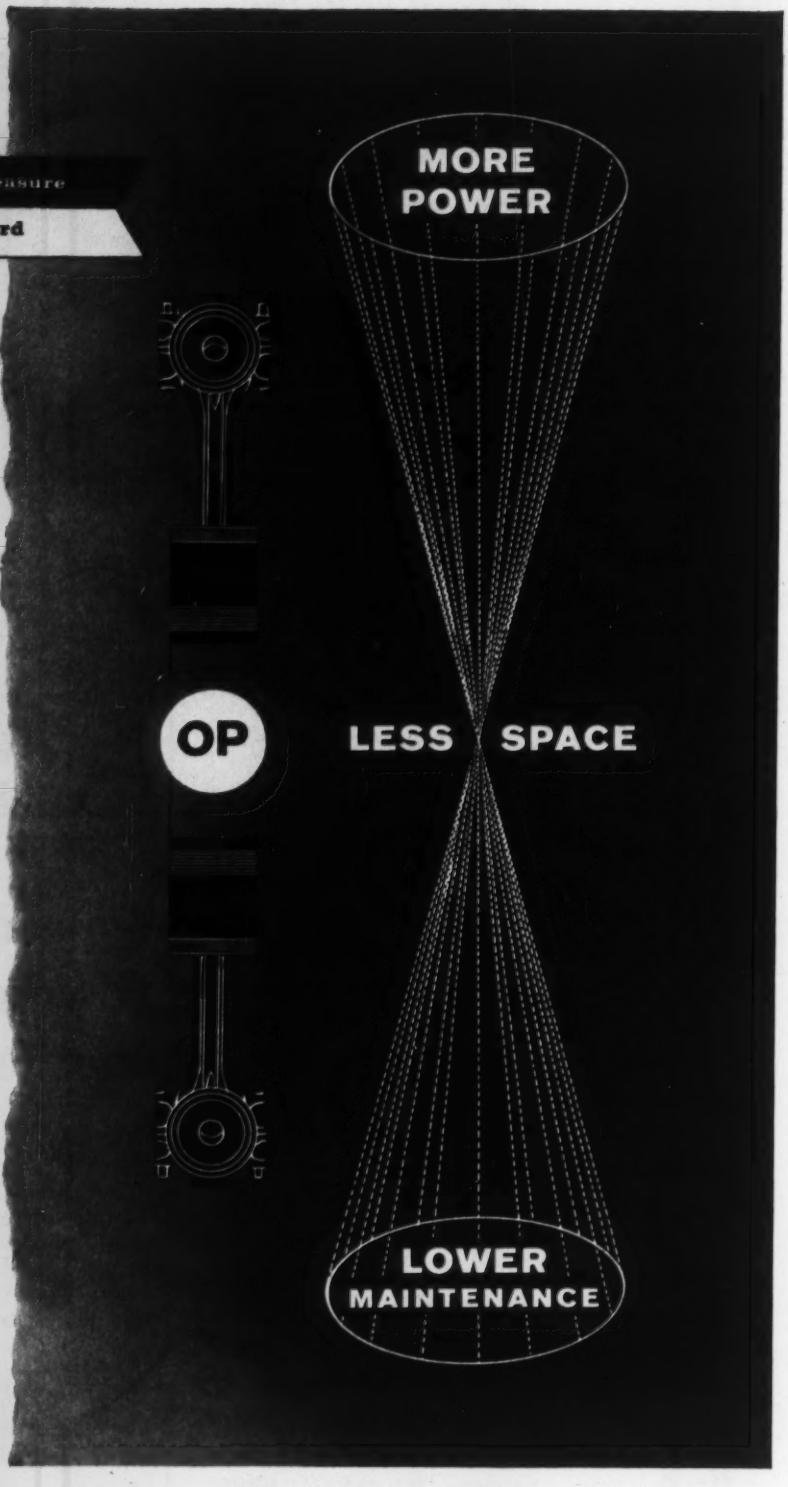
American Blower Division of American-Standard, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

AMERICAN BLOWER

Division of AMERICAN-Standard

Where performance is the measure

F-M Power is the standard



Only Fairbanks-Morse Opposed-Piston Diesels offer all these advantages:

Opposed-Pistons . . . of equal weight reacting to combustion in a single cylinder liner producing more power in less floor space with less weight—power that is instantly responsive with practically no vibration.

Two-Cycle Design . . . that completely eliminates more than 40% of the moving—wearing—parts found in engines of comparable horsepower. No cylinder heads, no valves or intricate timing with its attendant adjustments. Fewer parts automatically mean less maintenance. Low B.M.E.P. further reduces wear.

Uniflow Scavenging . . . that eliminates crosscurrents, pockets. Provides greater horsepower, increased thermal efficiency for the utmost in fuel economy.

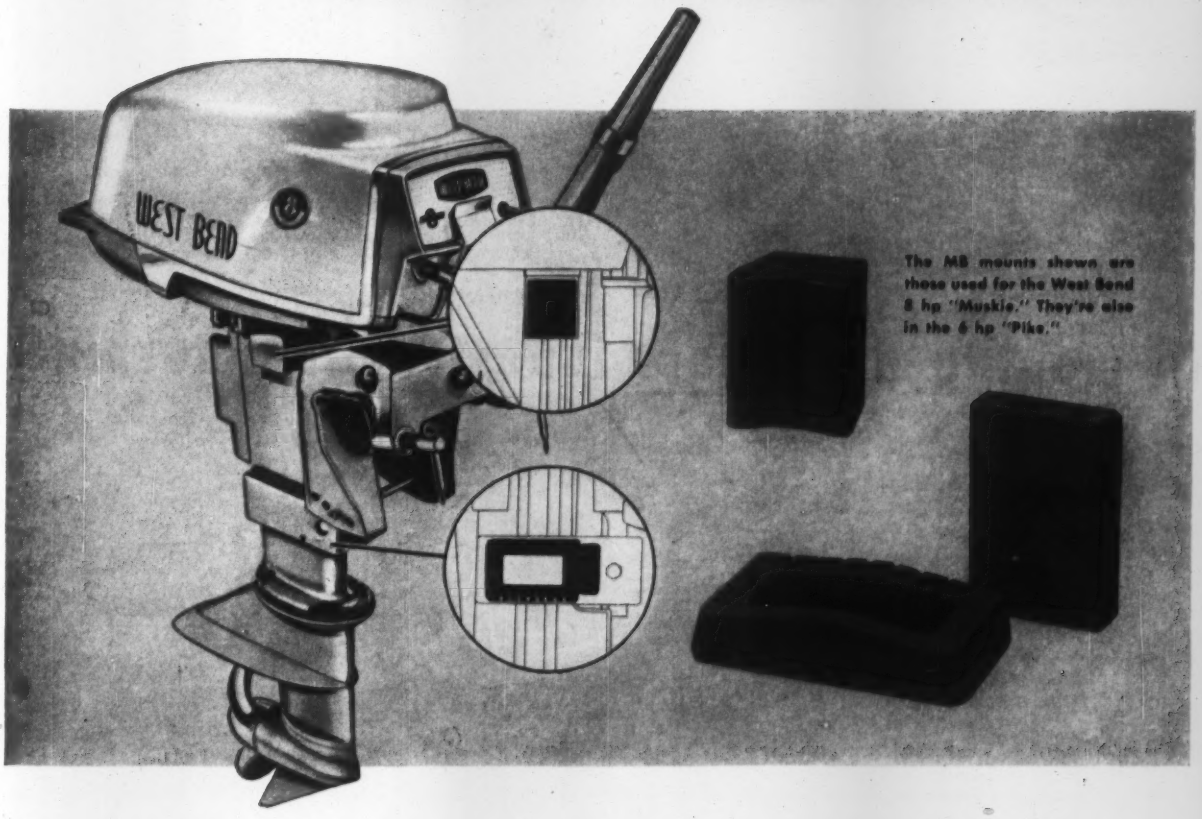
More Dependable Power...
Insist on an O-P in the 200 to 2400 horsepower class and see what top performance, reliability and economy can mean in dependable power generation. For complete information to get you started, write: Fairbanks, Morse & Co., Dept. ME-7, Chicago 5, Illinois.

FAIRBANKS-MORSE

a name worth remembering when you want the BEST

DIESEL AND DUAL FUEL ENGINES • DIESEL LOCOMOTIVES • RAILCARS • ELECTRICAL MACHINERY • PUMPS • SCALES • HOME WATER SERVICE EQUIPMENT • MOWERS • MAGNETOS

this *smooth power* floats on MB mounts



WEST BEND outboard motors for 1957 feature new colors, wider range of ratings. But one thing doesn't change: Their freedom from annoying vibration. Special MB vibration mountings, as they have for years, isolate motor from boat.

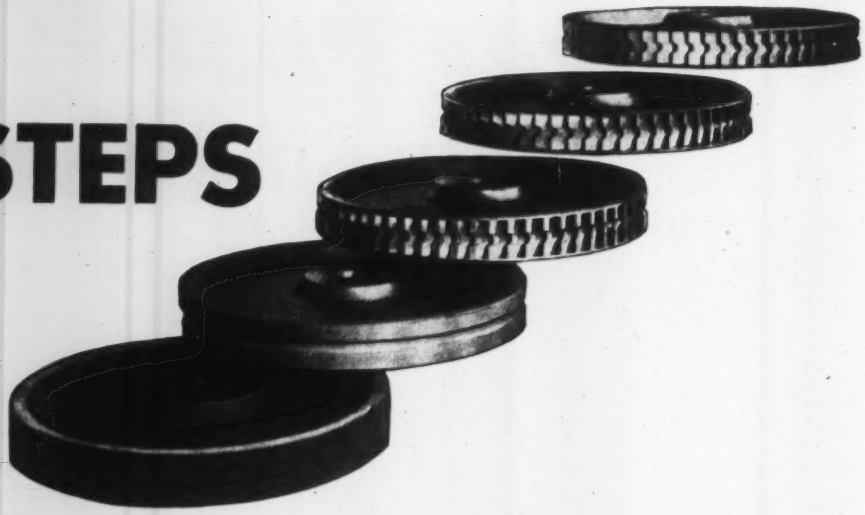
Satisfactory isolation of outboards can be difficult to achieve. Modes of motion are rougher; underwater service conditions are hardly ideal; and the location of suspension points is relatively restricted. Specially engineered, all-neoprene MB mounts overcome these problems... taming torque from engine, and cushioning impulse from propeller.

MB concentrates on mounts which start where ordinary units have to give up. While *standard* units are available, MB mounts are actually in the *special performance* class. Perhaps we can work out a modification of one to solve *your* troublesome vibration problem. Send for Bulletin 616A.

manufacturing company
A Division of Textron Inc.
1074 State Street
New Haven 11, Conn.

HEADQUARTERS FOR PRODUCTS TO ISOLATE VIBRATION... TO EXCITE IT... TO MEASURE IT.

5 STEPS



in making an almost indestructible turbine

The rotor of a Terry solid-wheel turbine is a single forging of special composition steel. It is first rough turned in two operations, as shown, and then two cuts are taken to mill the semi-circular buckets from the solid metal. The wheel at the top has been finished, ready for mounting on the shaft. *The result is a single-piece wheel with no parts to loosen or wear out.*

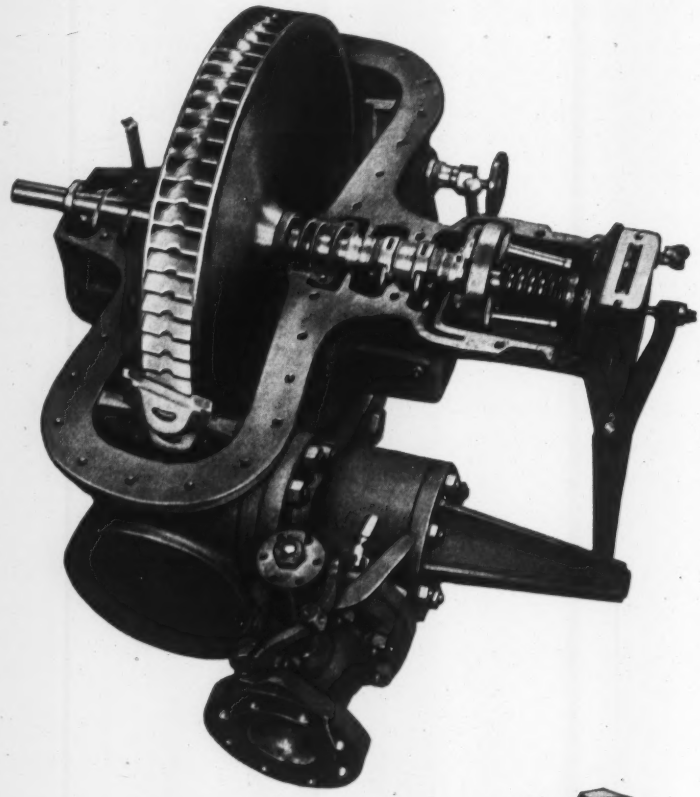
Blade wear, which might occur after many years of usage, is not important, because the power-producing action of the steam takes place on the curved surfaces at the backs of the buckets. Thus wear does not materially affect horsepower or efficiency.

The blades can't foul. They have a one-inch clearance, and are further protected by the projecting rims at the sides of the wheel.

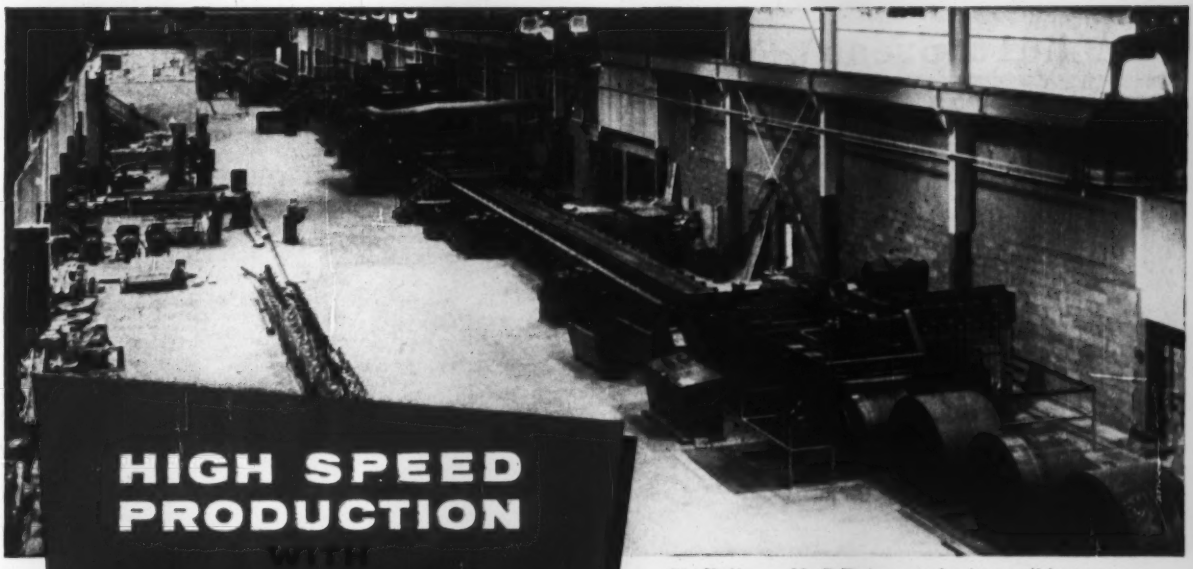
The Terry solid-wheel turbine is an extremely reliable piece of equipment. Write for details—today. Ask for a copy of bulletin S-116.

THE
TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT-1204



TERRY



Six Reliance V★S Drives make it possible to operate this complete line as if it were a single machine.

Carloads of pipe are pouring out of the new Edmonton, Alberta plant of Alberta Phoenix Tube & Pipe, Ltd. This $6.5 million installation is producing pipe at unprecedented rates.

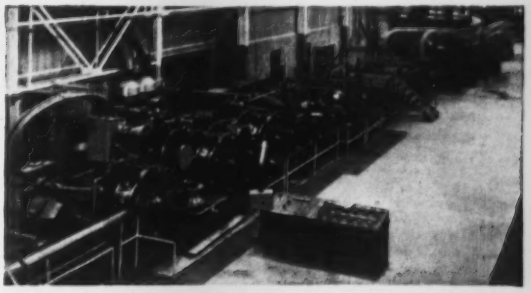
Volume pipe production requires something special in a drive system—one that furnishes precise speed control and instantaneous motor response. A wide stepless range of speeds is provided to handle various pipe diameters and lengths, and all sections of the line operate at the same relative speed.

A team of Reliance Application Engineers, working with the machinery builder, built this specialized drive. This team knows the processes of the steel industry and how to handle the problems involved. Engineering knowledge, backed by the quality of Reliance products, supplied this accurate, simple-to-operate, economical drive.

The Reliance Application Engineering Department builds drives for every industry. A team of engineers who are experts on your industry's operation, stand ready to engineer and build the drive for your particular needs.

If you would like more information on this installation, write for Bulletin L-2505.

L 1641



The welding section operator controls the speed of the entire line from this Reliance Pendent Station.

The Reliance V★S Drive on this flying cutoff automatically measures the pipe and controls the movement and speed of the carriage.

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 297A, CLEVELAND 17, OHIO · CANDIAN DIVISION: WELLAND, ONTARIO

Sales Offices and Distributors in Principal Cities

A Multipress case study

Multipress, used here for staking chromium-plated pepper mill lids, saves 11¢ per unit for specialty manufacturer.

MULTIPRESS® saves specialty manufacturer 11¢ per unit

By using a Denison hydraulic Multipress equipped with simple interchangeable tooling, The George S. Thompson Corporation, South Pasadena, California, manufacturer of the Olde Thompson line of pepper mills and gourmet accessories, is now saving 11¢ on each pepper mill produced.

Previous methods for three sub-assembly operations cost the company 15¢ per unit. With the hydraulic Multipress, costs for these three operations have been reduced to 4¢ per unit. In addition to this significant cash savings, rejects have been virtually eliminated and production has been substantially increased.

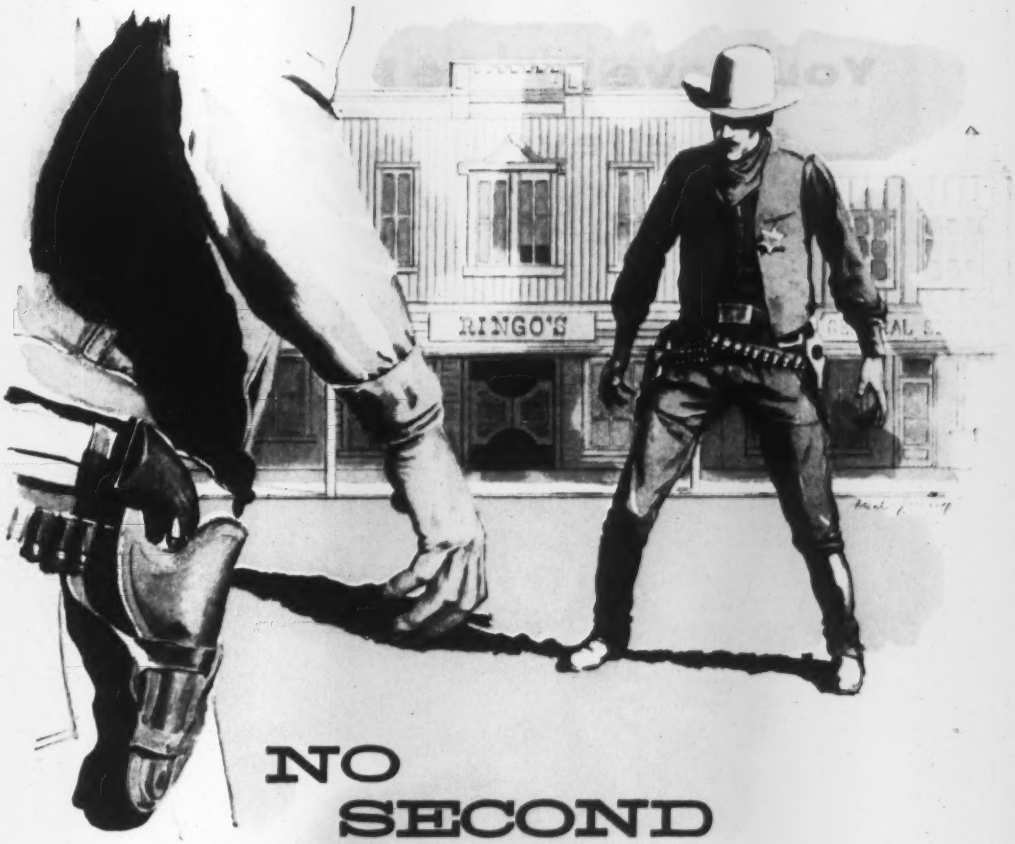
The interchangeable fixtures on the index table permit the Multipress to be used for short-run jobs. Downtime for change-over is eliminated.

Learn how Multipress can reduce your production costs. Write Denison Engineering Division, American Brake Shoe Co., 1174 Dublin Road, Columbus 16, Ohio.

Write for Datalog ASY-5 describing this money-saving method.

DENISON HydrOILics

HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS



NO SECOND BEST

When an aggressor threatens, you can't be **second best.**

That's the way **it is** in our business, too.

Our business is design and development of nuclear weapons—weapons that stop potential aggressors and defend our freedom.

And in this kind of work, either you're best, or you're nothing.

We can't afford to settle for less than the best—ever.

That applies to our engineers and scientists, too. As our job and its importance grows, we need more capable scientists. To those who qualify, we offer exciting opportunities for professional growth and individual advancement. Engineers, physicists, mathematicians, and other scientists are needed in a broad range of specialized fields.

We offer attractive living, too. In Albuquerque, a fine climate and a blending of ancient and modern cultures provide pressure-free, relaxed, pleasant living. The University of New Mexico, located here, provides opportunity to earn advanced degrees under a Sandia-sponsored educational aids program. Varied recreational activities are nearby and homes for rent or purchase are available.

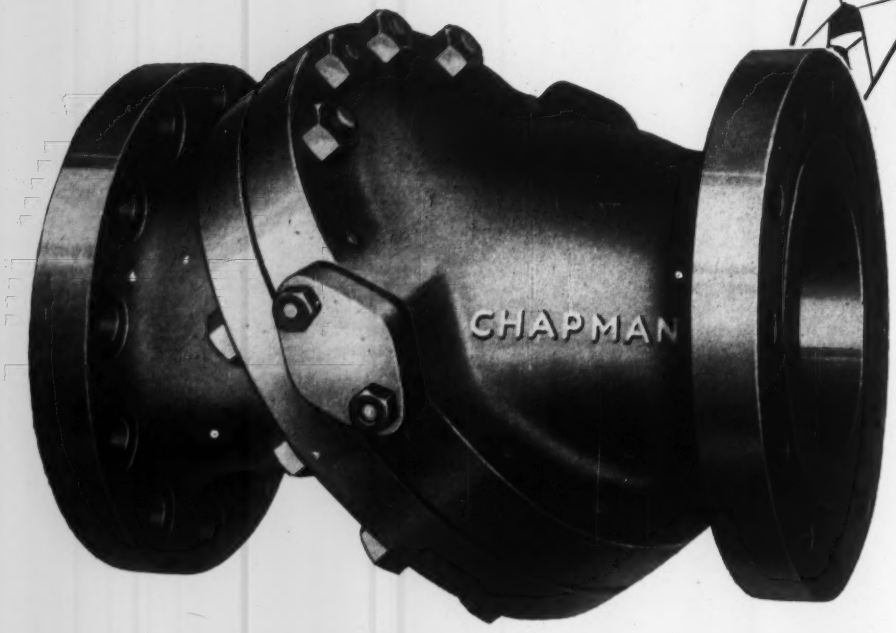
MORE INFORMATION about Sandia Corporation, the work we do, and the opportunities now available are contained in our illustrated brochure. For your copy, please write Staff Employment Division 553.

SANDIA CORPORATION

ALBUQUERQUE, NEW MEXICO

You have to see it to believe it . . .

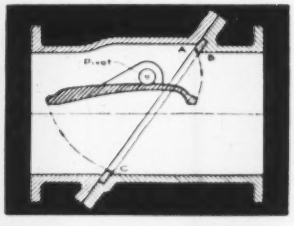
(You Can't Hear It!)



CHAPMAN Tilting Disc Check Valve

It's the silent valve. No noise, no vibration, no fluttering. On usual piping arrangements you get no slamming with a Chapman Tilting Disc Check Valve. You get no banging to cause damage to system or valve . . . no grinding, scraping or wearing of either the disc or seat. Your maintenance costs go down to an unbelievable low which is really something to see and enjoy.

You can safely use these valves under tough operating conditions. You can order them in iron and steel . . . for handling fluids or gases under a wide range of pressures. You can get them fast. See our Catalog 30-A. Write for your copy today.

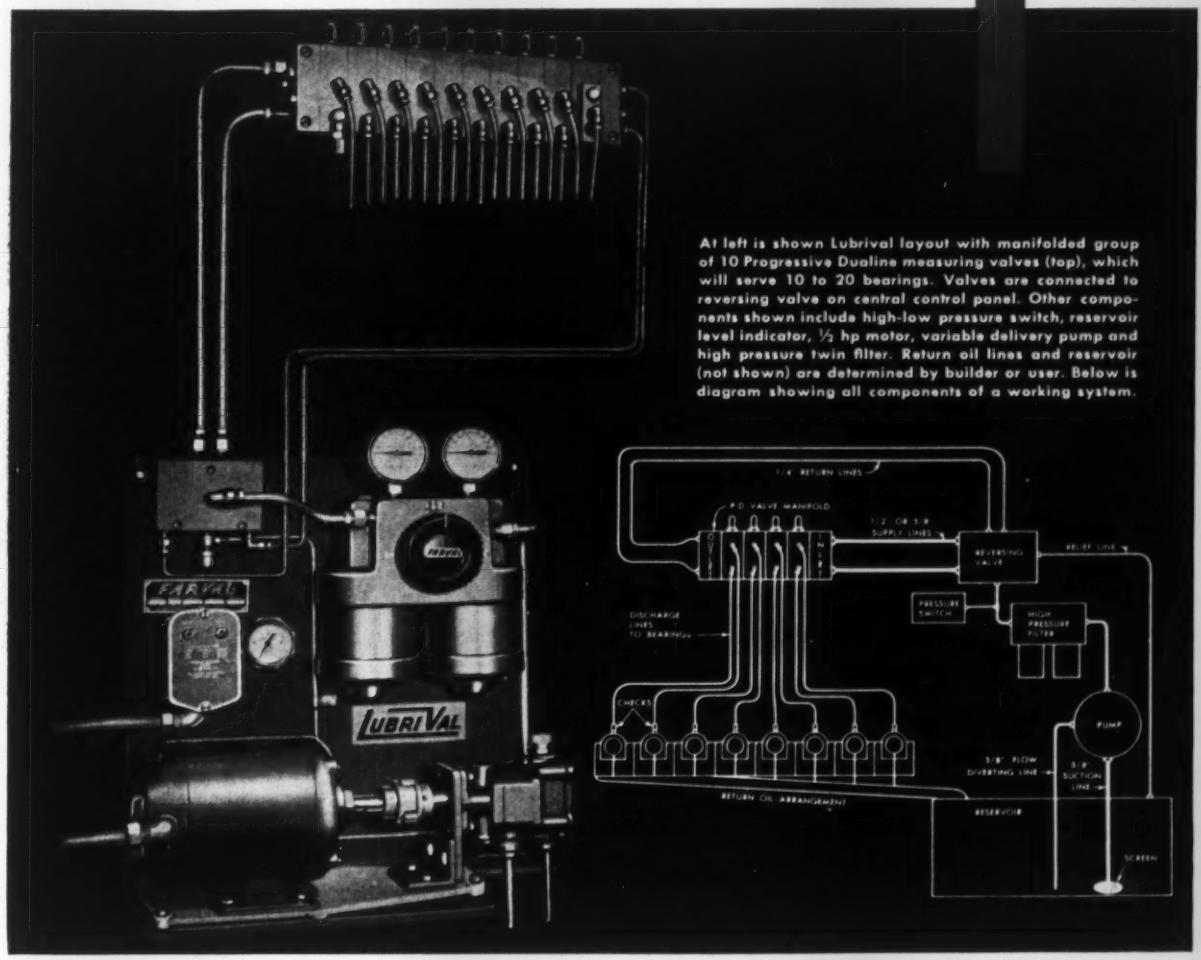


Look at this operational chart. When the flow is on, "airfoil" disc is held firmly against stops in the body. When the flow drops, disc balances quietly on whatever flow there is. When flow stops, disc drops quickly, quietly and firmly on special bevel seat. Note that sufficient space is designed around disc to cut down flow resistance.

THE CHAPMAN VALVE MANUFACTURING CO.
INDIAN ORCHARD, MASSACHUSETTS

LUBRIVAL —a revolutionary new system to supply and circulate lubricating oil

FARVAL—
Studies in Centralized Lubrication
No. 204



At left is shown Lubrival layout with manifolded group of 10 Progressive Dualine measuring valves (top), which will serve 10 to 20 bearings. Valves are connected to reversing valve on central control panel. Other components shown include high-low pressure switch, reservoir level indicator, ½ hp motor, variable delivery pump and high pressure twin filter. Return oil lines and reservoir (not shown) are determined by builder or user. Below is diagram showing all components of a working system.

● Lubrival is designed for low volume, high pressure circulating lubrication of presses, automatic and semi-automatic machine tools and other industrial equipment designed for circulating oil systems.

Lubrival is a Farval system, employing the Dualine principle of delivering oil to measuring valves which pass it under pressure to bearings. Lubricant is force-fed by positive piston displacement. Flow can be regulated over a range of 10 ounces to 1 gallon per minute.

Lubrival Progressive Dualine Valves, manifolded in any number required, have individual sight indicators. A pressure sensing mechanism warns of clogged or broken lines in *any part* of the system—a feature entirely new to circulating oil systems.

For dependable protection of bearings and economical operation of machines, look into Lubrival. If you are a builder, offer Lubrival protection to your customers. If you use presses and machine tools, specify Lubrival on your next equipment order. The Farval representative near you will give you all details. Or write for Bulletin 70. The Farval Corporation, 3264 East 80th Street, Cleveland 4, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing. In Canada: Peacock Brothers Limited.

KEYS TO ADEQUATE LUBRICATION—

Wherever you see the familiar Dualine valve manifolds, dual lubricant lines and central pumping station, you know a machine is being properly lubricated. Farval manually operated and automatic systems protect millions of industrial bearings.

...more quality proved POWELL VALVES

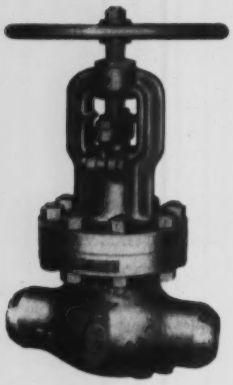


Fig. 6031S-WE—600-Pound Steel Globe Valve for Steam Service. Outside Screw Stem and Yoke.

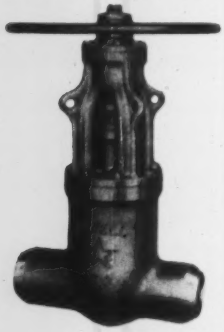


Fig. 19003—Powell Steel Pressure Seal Gate Valve for 900 Pounds W.S.P.

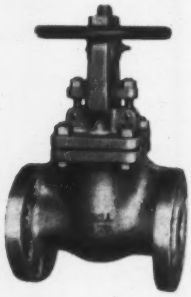


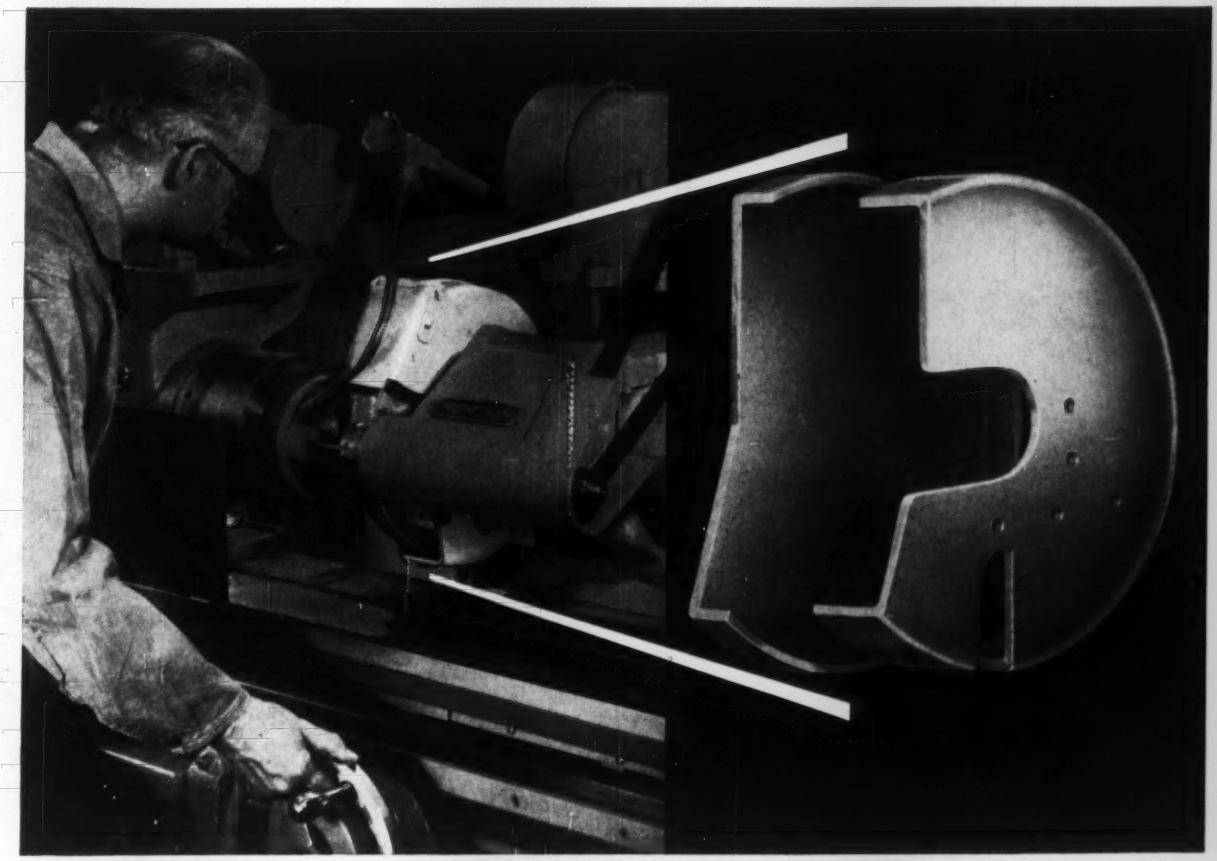
Fig. 2467—Small 300-Pound Stainless Steel O.S.& Y. Gate Valve. For handling boiler feed water treating solutions.

Fig. 1793—Iron Body Bronze Mounted O.S.& Y. Gate Valve for 125 Pounds W.S.P.

made with quality proved materials

Consult your Powell Valve Distributor for full facts about quality proved bronze, iron, steel, and corrosion-resistant valves. For every flow control problem—there is a Powell Valve to solve it . . . *better.*

THE WM. POWELL COMPANY, CINCINNATI 22, OHIO . . . 111th YEAR



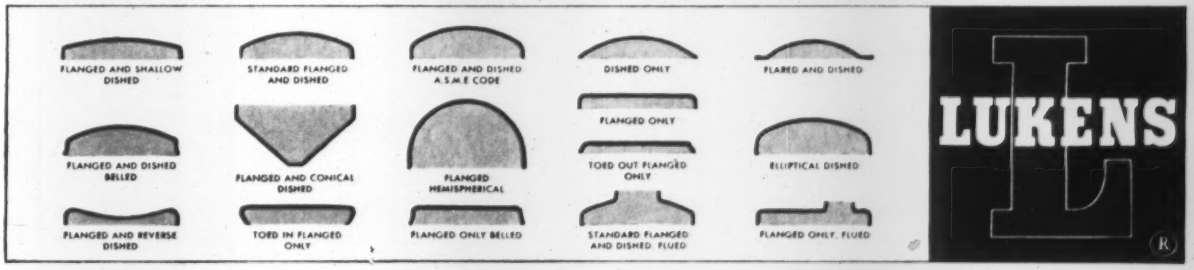
In this Norton Grinder, imaginative designing with Lukens heads simplified construction, saved money.

Improve your product...cut costs... designing with Lukens heads

■ Start to think about simplifying *your* designs, even redesigning, with Lukens standard head shapes. For Norton Company, Worcester, Mass., this led to stronger and safer grinding-wheel guards on machines such as this Type U-4 Universal Grinder—plus positive savings in cost and time. Two standard Lukens heads fitted together turned the trick.

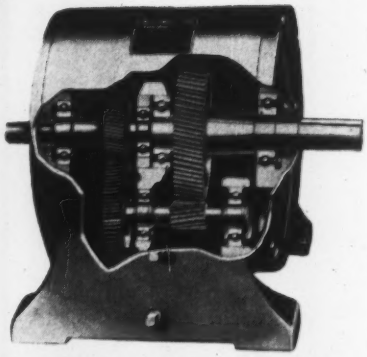
Where can preformed Lukens heads reduce design complexity and eliminate fabricating steps in your equipment? Put your imagination to work and see. Others have used them in wheels, valves, chemical equipment, heavy and light machinery. Lukens' fifty-five years as the leading producer of spun and pressed steel heads for many applications are at your service. Write for Catalog 930, *"Pricing and Engineering Data."* Lukens Steel Company, Coatesville, Pennsylvania.

Lukens Offers the World's Broadest Line of Spun and Pressed Heads of Carbon, Alloy and Clad Steels

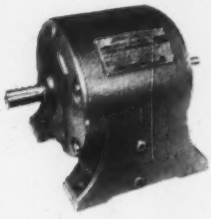


talk about benefits!

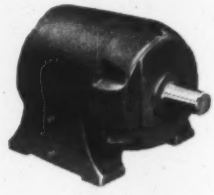
Get the benefit of Western Gear's 69 years experience in the design and manufacture of mechanical power transmission equipment when building a new plant or modernizing present installations. StraitLine reducers incorporate our own design abilities with careful attention to customer experience and design preferences. A complete line of all types of gear drives to 10,000 horsepower. Our application engineers are at your disposal.



Cutaway View Double Reduction Type RD



Double Reduction Type RD



Triple Reduction Type RT

check ✓ these **7 big reasons** why **Western Gear** StraitLine Speed Reducers can solve your in-line drive problems!

- ✓ Packaged sub-assemblies.
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- ✓ Double reduction units available to 100 HP in 15 standard ratios from 3.39:1 to 57.3:1.
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Many other plus features. For full details, get StraitLine Bulletin 5616. Use the coupon at left.

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Largest bronze centrifugal casting ever made, 54¼" O.D. x 49½" I.D. x 346½" long. Charge weight—72,300 pounds.

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It's the 47 years of specialized experience coupled with unequalled manufacturing facilities . . . that makes it routine for our engineers and production teams to cast and machine *cylinders from 7" to 54" O.D. and up to 33 feet in length* . . . in a wide range of alloys meeting special performance requirements.

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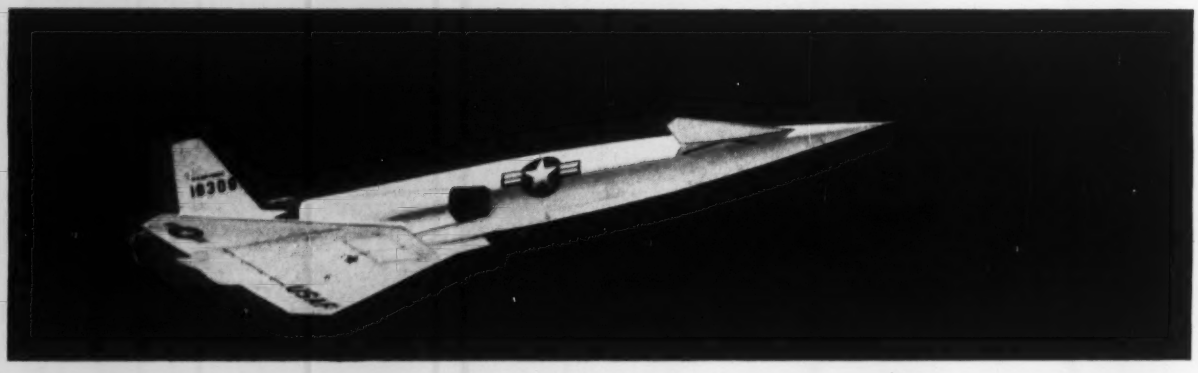
SANDUSKY, OHIO • *Stainless, Carbon, Low Alloy Steels—Full Range Copper-Base, Nickel-Base Alloys*

Engineers: This coupon means action!

Success of X-10 Test Missile program steps up systems engineering work on

Intercontinental SM-64 Navaho



The pace is quickening, as we gather forces for the climactic effort on the Navaho. If you like excitement in your engineering—this is it! You can decide now, and still get in on the work coming up at North American's Missile Development Division. It's going to be an assignment you'll be glad you took part in for years ahead.

James A. Trapp, 33, has been with NAA's Missile Division since 1952. He holds both BS and MS in Electrical Engineering. Now Group Leader, Auto Checkout Systems, he supervises development of digital techniques. Hi-fi fan and fisherman, this Oklahoman now lives in Long Beach with his wife and 2 California tots.

The Navaho is a project with the toughest kind of painstaking engineering behind it. It's been several years now since this organization set out to deliver to the Air Force a complete strategic weapon system. On the way we opened up and proved out more workable missile information than any other source: structures, guidance, propulsion, armament, ground handling, launching—the works. Now you can join us... get in at the forefront of missile technology. If you do, you're going to build a weapon with the world's most advanced self-contained guidance system ... driven at supersonic speeds by both rocket and ram-jet engines . . . and packing an accuracy/payload punch that's unbeatable in the foreseeable future.

Charles H. ("Chuck") Lauritsen, 31-year old ex-Navy man, hails originally from Beatrice, Neb. Study at Chicago, Northwestern and Michigan gave him his BS and MS, Aero Eng. Starting in 1947, he rose thru Group Leader to Section Head of Project Aerodynamics, responsible for aerodynamic analysis on all Division contracts.

Join us now. All the things it takes to perfect a major intercontinental missile are available to you here. You can step up your own career ... grow in stature while working with some of the finest minds in the missile field... and advance your education, if you wish, with our Tuition Refund Plan.

MISSILE DEVELOPMENT DIVISION OF

NORTH AMERICAN AVIATION, INC.

Mr. R. L. Cunningham, Engineering Personnel Manager, Dept. ME-7
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Dear Mr. Cunningham:

Please send me career information on Missile Development Division. I am interested in the following fields (check one or more).

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NOTHING *can equal Stainless Steel*

in its unique combination of properties

No other design material can match Stainless Steel in its combination of desirable properties: corrosion resistance, strength, hardness, beauty, cleanability and easy fabrication. For a reliable source of supply, United States Steel offers you the widest range of types, finishes and sizes.

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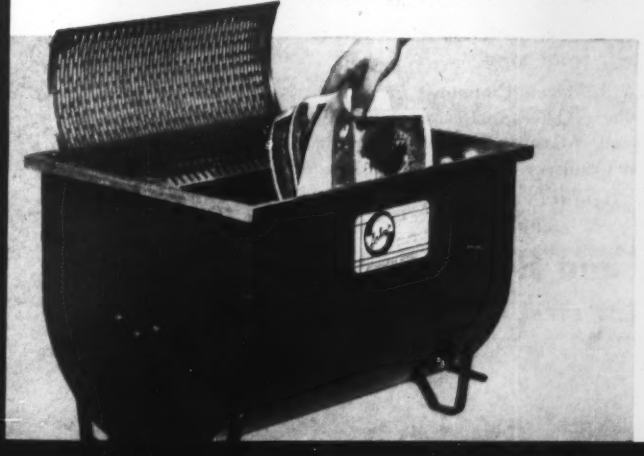
FOR HIGH TEMPERATURE STRENGTH. The Ryan Firebee is a pilotless jet airplane that flys about 600 mph at altitudes up to 40,000 feet. All three armed services are using it for target practice—to simulate attacking aircraft. Fuselage and turbojet engines use substantial quantities of Stainless Steel—mostly because of its excellent strength/density ratio at elevated temperatures.

FOR CORROSION RESISTANCE. If you're a photographer, you know that hypo is awfully corrosive. This print washer (it holds 75 8x10 prints in one loading) is made completely from Stainless Steel by the Arkay Corporation, in Milwaukee. For proof that Stainless is easy to fabricate, notice that the drum has 1,700 perforations, and double lockseam soldered joints are used throughout.



FOR TAKING A BEATING. These supermarket check-out counters are made from USS Stainless Steel. They withstand the pounding of heavy containers and are unaffected by corrosive meat and produce juices. It only takes 20 minutes for one girl to clean all eleven counters shown here. The Robert Becht Company of Cincinnati made them.

Standing guard against corrosion, these wrought iron chilled water lines assure uninterrupted cooling facilities for Continental National Bank in Fort Worth, Texas.

Air Conditioning with Wrought Iron Pipe saves premature maintenance and replacement costs

Wrought iron pipe's ability to last a long, long time in air-conditioning service can save the cost of emergency repairs usually associated with less durable piping materials.

This resistance to corrosive attack stems from the thousands of iron silicate fibers which make up wrought iron's structure. These glasslike, non-rusting fibers prevent pitting and rapid penetration.

We have case history evidence of wrought iron pipe's reliability in carrying corrosive brines and waters. Our booklet, *Wrought Iron in Refrigeration and Air Conditioning Systems,* gives the details. Write for a copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Division Offices in Boston, New York, Philadelphia, Washington, Atlanta, Pittsburgh, Chicago, St. Louis, Houston, San Francisco. International Division: New York, N.Y.

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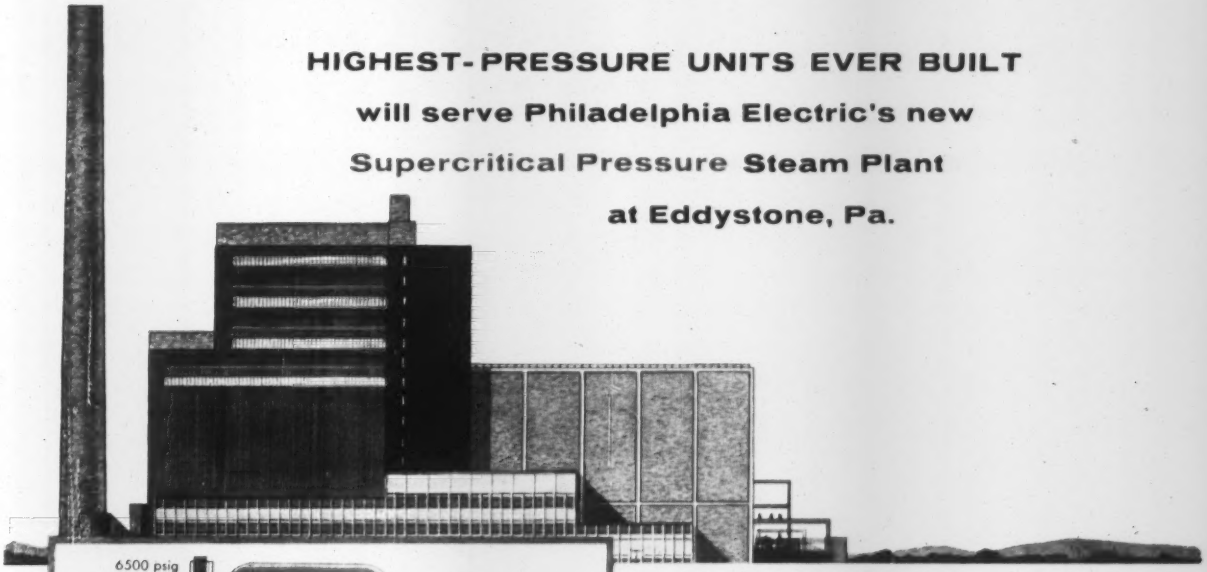
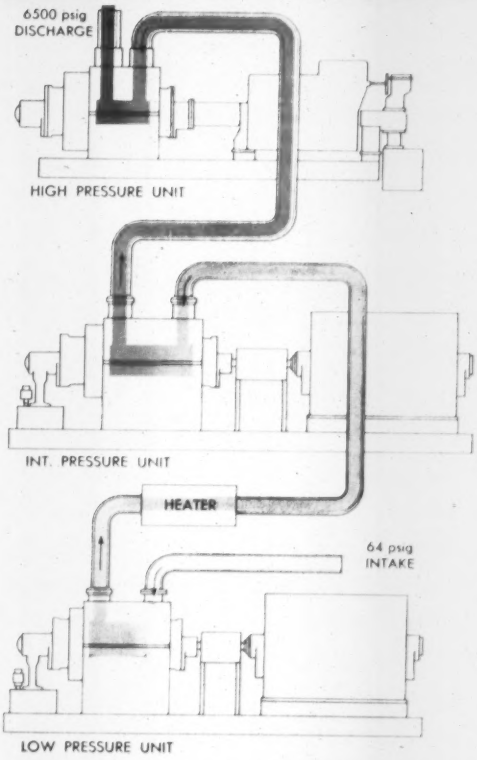
6500 psig
BOILER-FEED PUMPS

HIGHEST-PRESSURE UNITS EVER BUILT
will serve Philadelphia Electric's new
Supercritical Pressure Steam Plant
at Eddystone, Pa.





Feed water at approximately 6500 psig will be provided by six CHTA pumps, operating as two half-capacity pumping units. Each pumping unit will consist of 3 pumps in series as shown above.

SCHEDULED to go on the line in 1959, Philadelphia Electric Company's 325,000 kw Eddystone Station will operate at a higher steam temperature and pressure than any installation thus far announced. Using supercritical pressure and two reheat stages, it will require less fuel per kw-hr than the most efficient power station now in operation.

The steam generator will be served by six Ingersoll-Rand double-case pumps. To provide the required pressure and capacity they will be arranged as two half-capacity pumping units each consisting of three pumps in series. The suction pressure will be 64 psig and the discharge approximately 6500 psig. The final discharge temperature is 575° F. Featuring Ingersoll-Rand's proven *Unit-Type Rotor Assembly*, these pumps will be the highest-pressure boiler feeders ever built. Special stuffing box designs will be used to control leakage at this supercritical pressure.

The selection of I-R pumps for this historic installation reflects the confidence of Philadelphia Electric Company in Ingersoll-Rand's ability to design and build equipment for pressures and temperatures never before encountered in boiler-feed service.

Whatever your boiler-feed requirements, they can be met to advantage with Ingersoll-Rand centrifugal pumps of proved dependability and economy.

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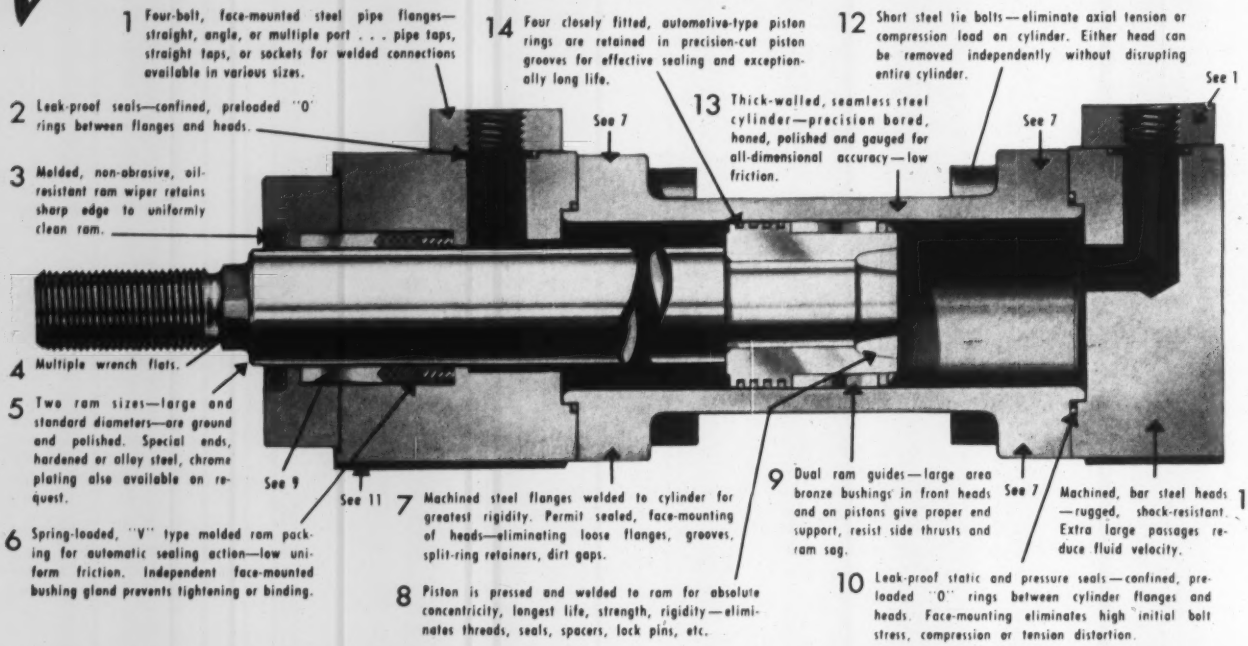
. . . Fluid Power news

NEW HEAVY DUTY CYLINDERS

NOW AVAILABLE—New Oilgear "Custom-Quality" Line of Heavy-Duty, 3,500 psi Cylinders

✓Check . . . Compare these 20 "Custom-Quality" features:



1 Four-bolt, face-mounted steel pipe flanges—straight, angle, or multiple port . . . pipe taps, straight taps, or sockets for welded connections available in various sizes.

2 Leak-proof seals—confined, preloaded "O" rings between flanges and heads.

3 Molded, non-abrasive, oil-resistant ram wiper retains sharp edge to uniformly clean ram.

4 Multiple wrench flats.

5 Two ram sizes—large and standard diameters—are ground and polished. Special ends, hardened or alloy steel, chrome plating also available on request.

6 Spring-loaded, "V" type molded ram packing for automatic sealing action—low uniform friction. Independent face-mounted bushing gland prevents tightening or binding.

7 Machined steel flanges welded to cylinder for greatest rigidity. Permit sealed, face-mounting of heads—eliminating loose flanges, grooves, split-ring retainers, dirt gaps.

8 Piston is pressed and welded to ram for absolute concentricity, longest life, strength, rigidity—eliminates threads, seals, spacers, lock pins, etc.

9 Dual ram guides—large area bronze bushings in front heads and on pistons give proper end support, resist side thrusts and ram sag.

10 Leak-proof static and pressure seals—confined, preloaded "O" rings between cylinder flanges and heads. Face-mounting eliminates high initial bolt stress, compression or tension distortion.

11 Machined, bar steel heads—rugged, shock-resistant. Extra large passages reduce fluid velocity.

12 Short steel tie bolts—eliminate axial tension or compression load on cylinder. Either head can be removed independently without disrupting entire cylinder.

13 Thick-walled, seamless steel cylinder—precision bored, honed, polished and gauged for all-dimensional accuracy—low friction.

14 Four closely fitted, automotive-type piston rings are retained in precision-cut piston grooves for effective sealing and exceptionally long life.

15 Adjustable hydraulic cushions—dash pots—for front, rear, or both heads. New, exclusive Oilgear floating-sleeve design assures superior performance, longer life, less wear—eliminates check valves.

16 Eight basic sizes—2", 2½", 3¼", 4", 5", 6", 7", 8" . . . length of stroke varies from 36" to 158". Longer stroke available on request.

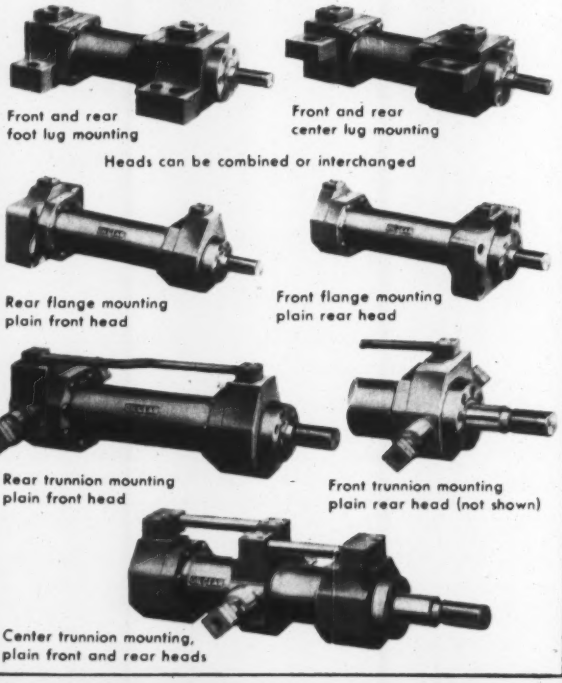
17 Air vent plugs, double end rams, special ram ends, special packings for use with fire-resistant fluids are also available.

18 Choice of fixed mountings—foot lug, center lug, or flange—can be combined or interchanged, front or rear, to suit any requirement.

19 Choice of hollow trunnion mountings—rear, center, front—accurately machined, integral with heads. No hoses or slide joints—Oilgear's exclusive steel flange connectors—rugged, leak-proof, rotate smoothly.

20 Designed and built to the highest standard of quality for the most dependable, trouble-free, long life. Machinery builders and users alike, say—"For the lowest cost per year—it's Oilgear!"

STANDARD MOUNTINGS



Front and rear foot lug mounting

Front and rear center lug mounting

Heads can be combined or interchanged

Rear flange mounting plain front head

Front flange mounting plain rear head

Rear trunnion mounting plain front head

Front trunnion mounting plain rear head (not shown)

Center trunnion mounting, plain front and rear heads

Complete user satisfaction is guaranteed by Oilgear's extensive research, testing, over 35 years of design, manufacturing, and application experience in the field of Fluid Power—both oil and fire-resistant fluids.

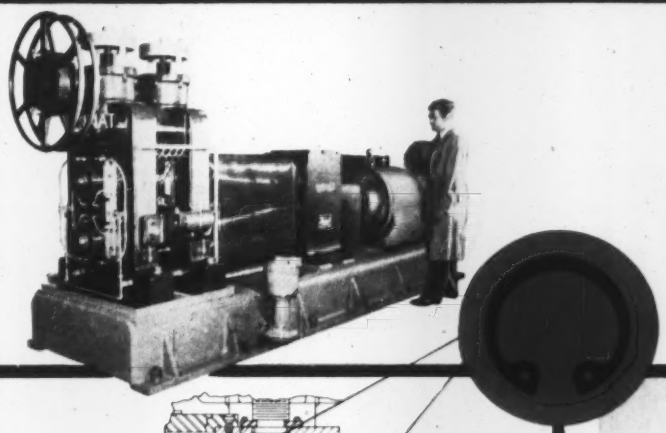
For further information on these new cylinders, call your Oilgear Application-Engineer. Or write for bulletins 73000 and 73245 directly to . . .

THE OILGEAR COMPANY

Application-Engineered Fluid Power Systems

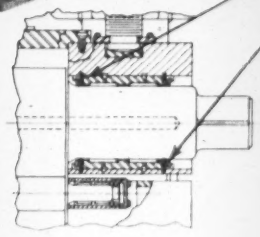
1570 WEST PIERCE STREET • MILWAUKEE 4, WISCONSIN

7-inch Waldes Truarc retaining rings cut costs, speed assembly-disassembly of 2-high/4-high mill

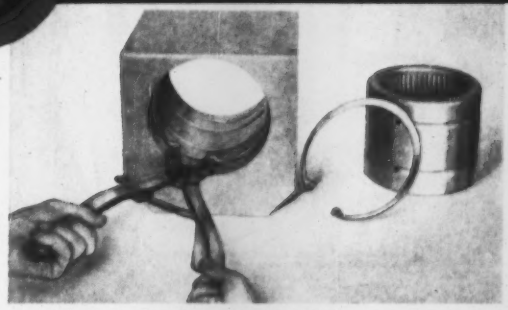


New Model TA-625 2-high/4-high combination rolling mill designed by Stanat Manufacturing Co., Long Island City, N. Y., reduces 2½" ingot to precision-rolled strip as thin as .001".

Waldes Truarc retaining rings help make possible a complete change of work rolls in 20 minutes... solve difficult problems of accuracy control by achieving positive location of bearings to extremely close tolerances. Rings eliminate costly parts and machining, save space, reduce maintenance.



In the assembly illustrated above, 7" Waldes Truarc (Series 5000) retaining rings—three on each roller—are used to position heavy-duty needle bearings in the bearing housing. Smaller rings position bearings in other roller assemblies and retain the shaft of a dual handwheel screwdown. All in all, 18 Waldes Truarc rings are used in the mill. They replace machined shoulders, spacers and lock nuts... eliminate costly threading, other machining operations.



Assembly is simple, even with giant 7" diameter Truarc ring. Special Truarc ratchet pliers grasp the ring securely, ease it into the groove, snap it securely into position. Smaller pliers and various high-speed assembly jigs are available for other rings, permit assembly-disassembly to be performed rapidly even by unskilled labor.

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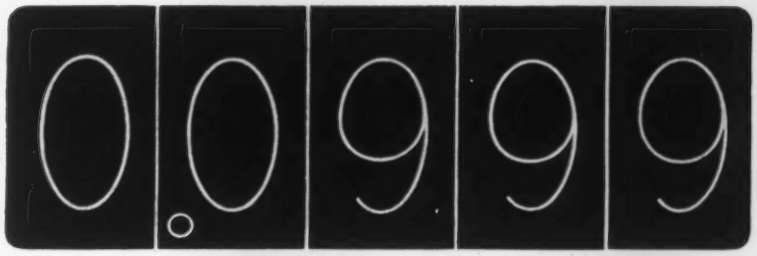

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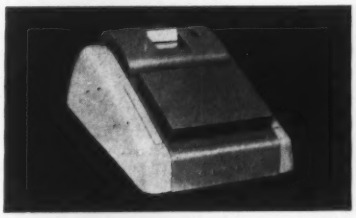

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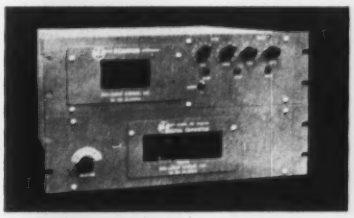

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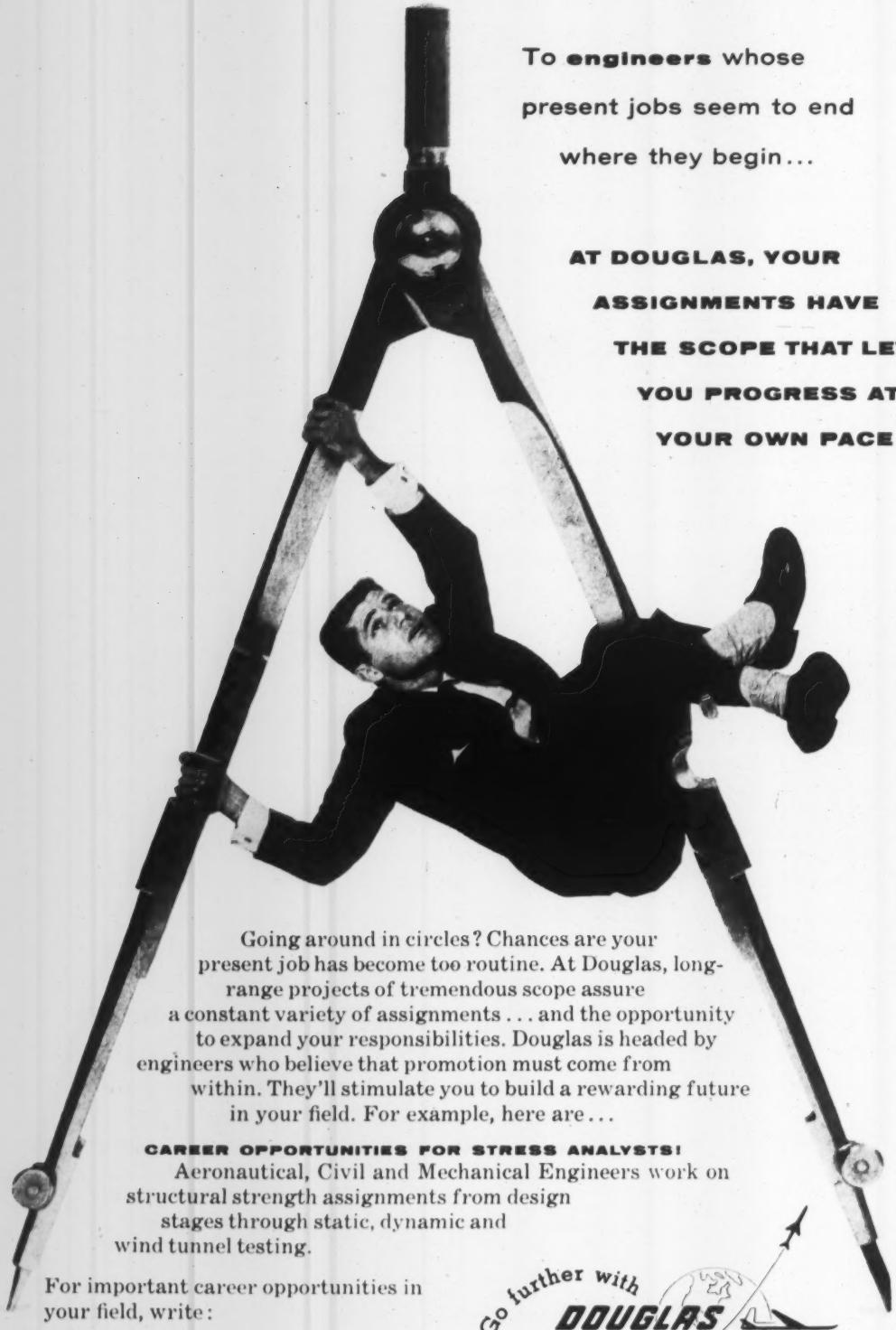

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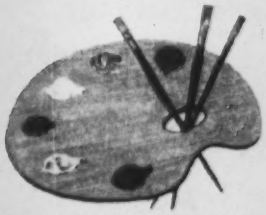

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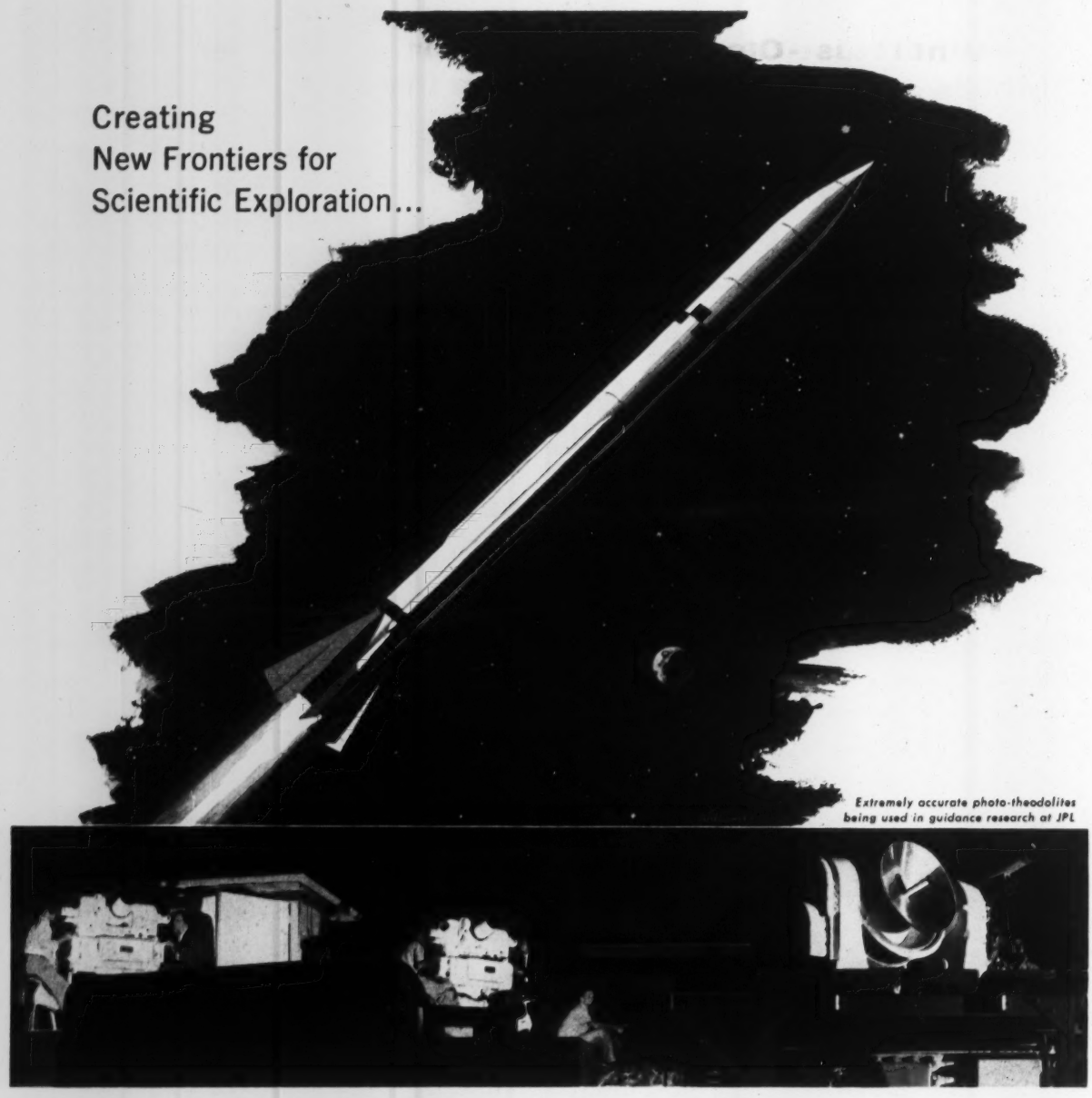

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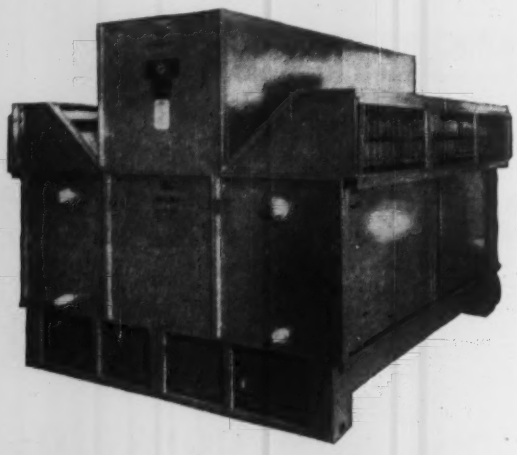

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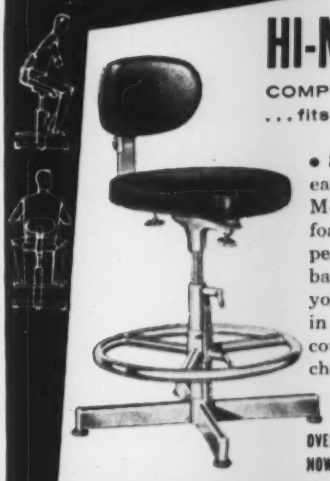

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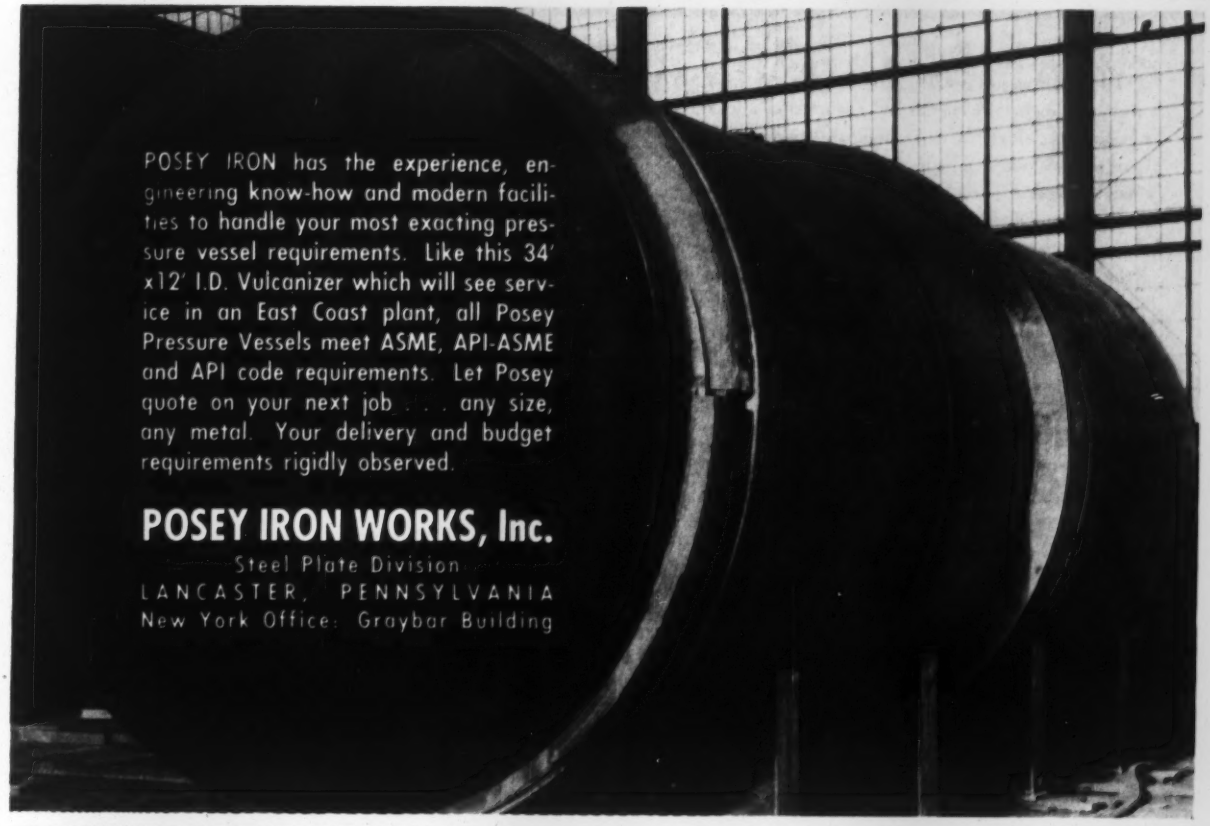

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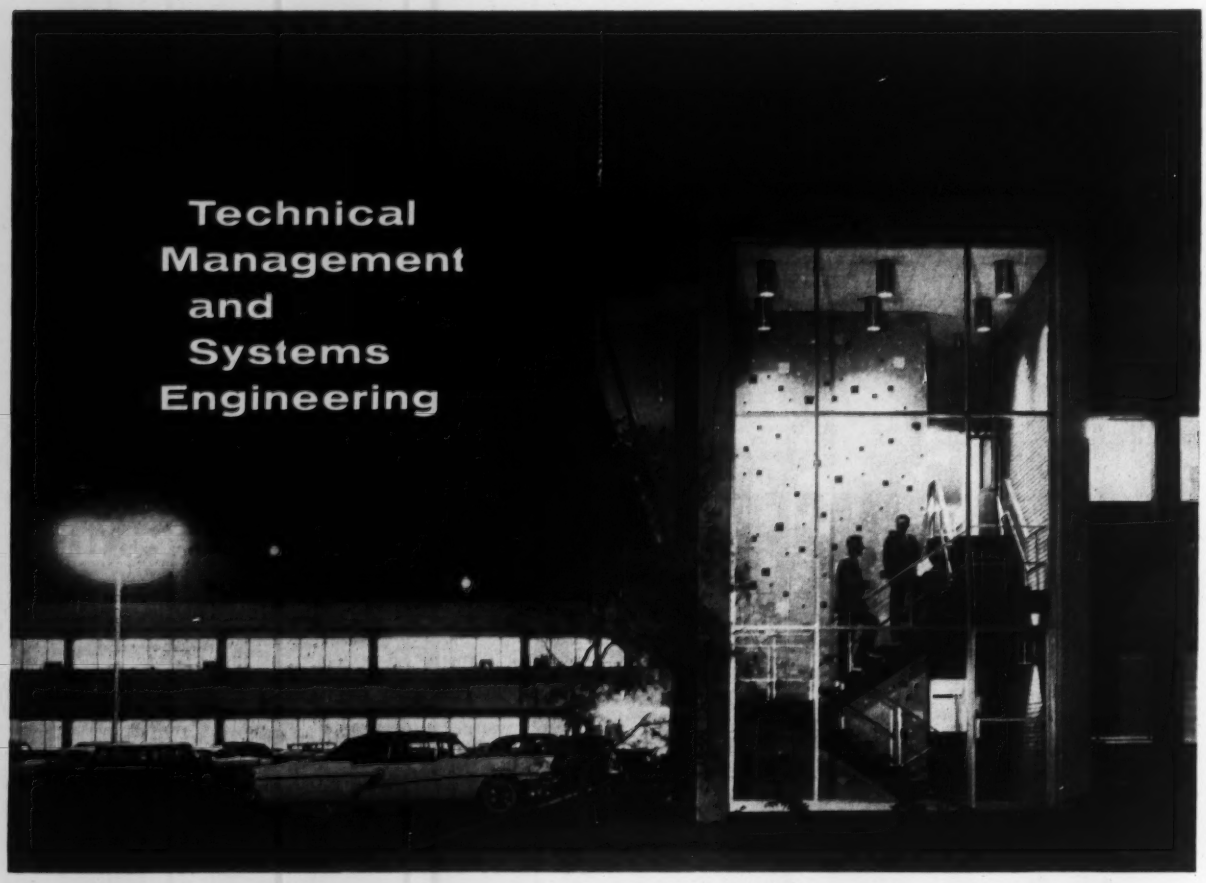

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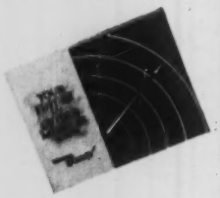

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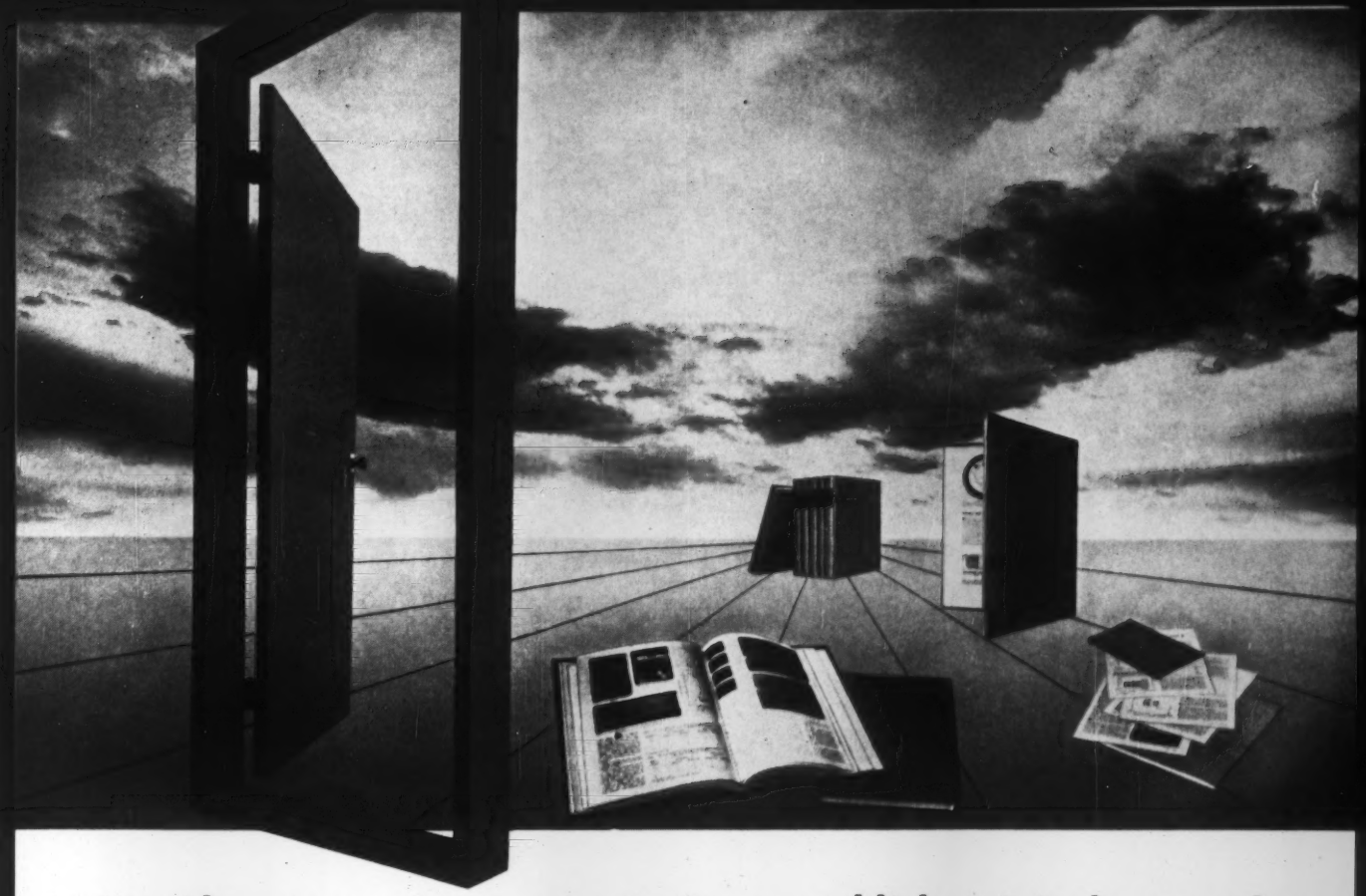

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W. W. Wood and J. G. Kirkwood, J. App. Phys. **28**, *395 (1957).*

COMPRESSION OF SOLIDS BY STRONG SHOCK WAVES
M. H. Rice, R. G. McQueen, and J. M. Walsh, Solid State Physics—Advances in Research and Applications, Vol. **6** *(In Press).*

PRECISION FLASH X-RAY DETERMINATION OF DENSITY RATIO IN GASEOUS DETONATIONS
R. E. Duff and H. T. Knight, J. Chem. Phys. **25**, *1301 (1956).*

POLYMORPHISM OF IRON AT HIGH PRESSURE
D. Bancroft, E. L. Peterson, and S. Minshall, J. App. Phys. **27**, *291 (1956).*

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F. A. Lucy, J. Opt. Soc. Am. **46**, *699 (1956).*

VISIBLE RADIATION FROM HELIUM IN A STRONG SHOCK WAVE
G. E. Seay and L. B. Seely, Jr., Bull. Am. Phys. Soc. **II**, **1**, *227 (1956) (Abstract).*

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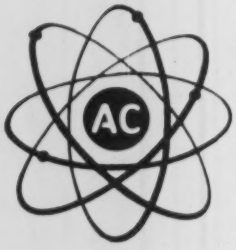

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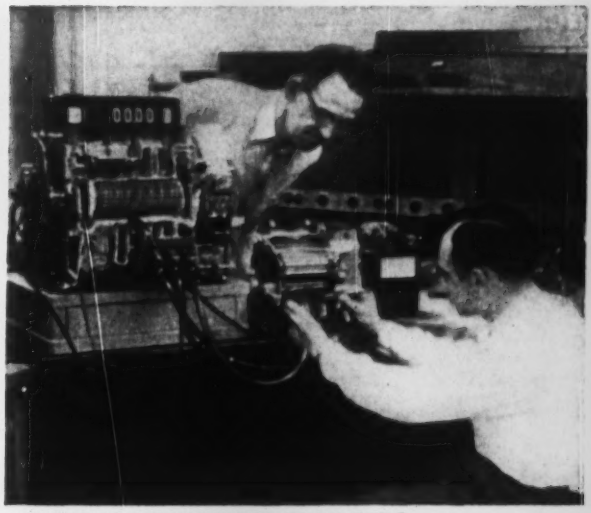

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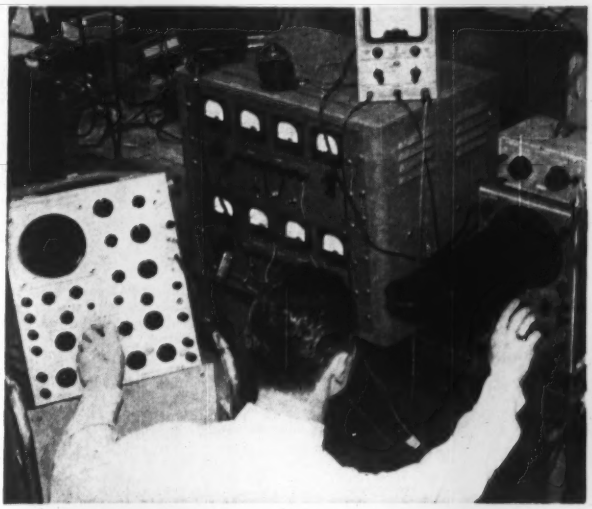

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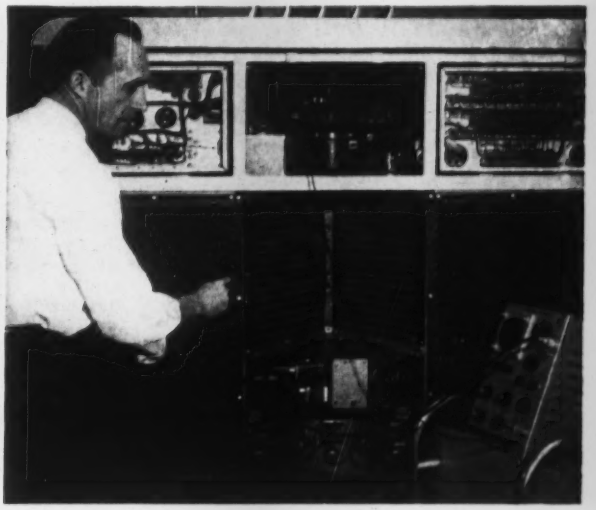

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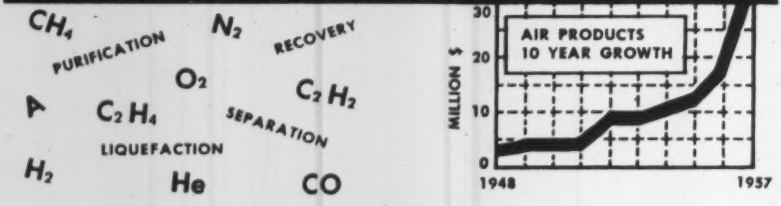

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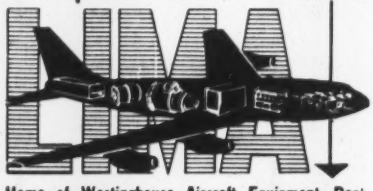

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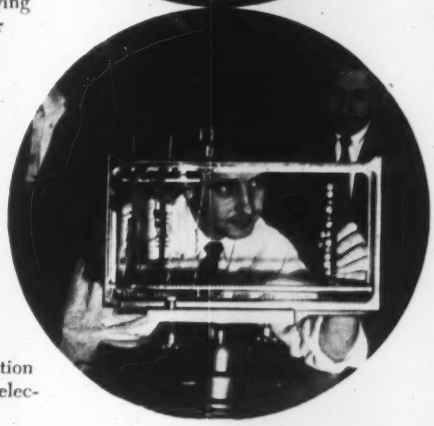

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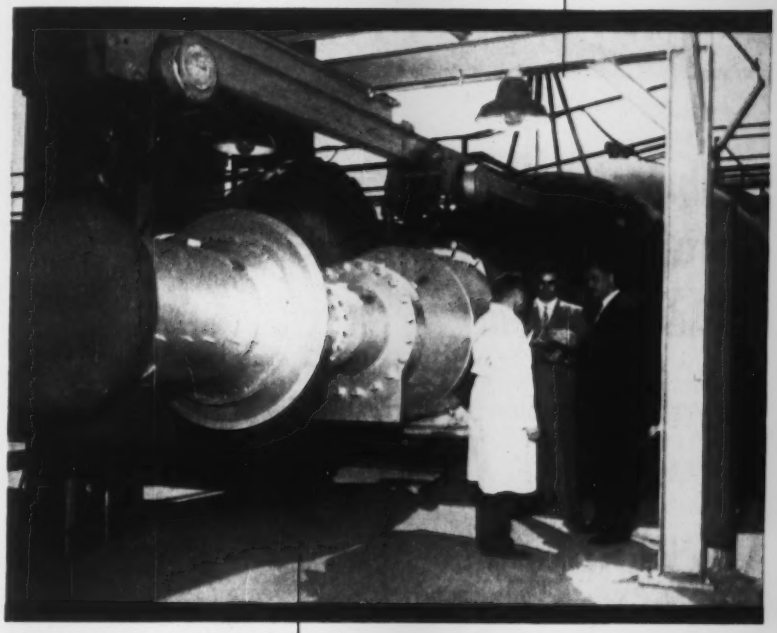

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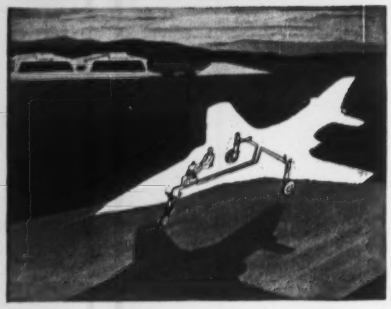

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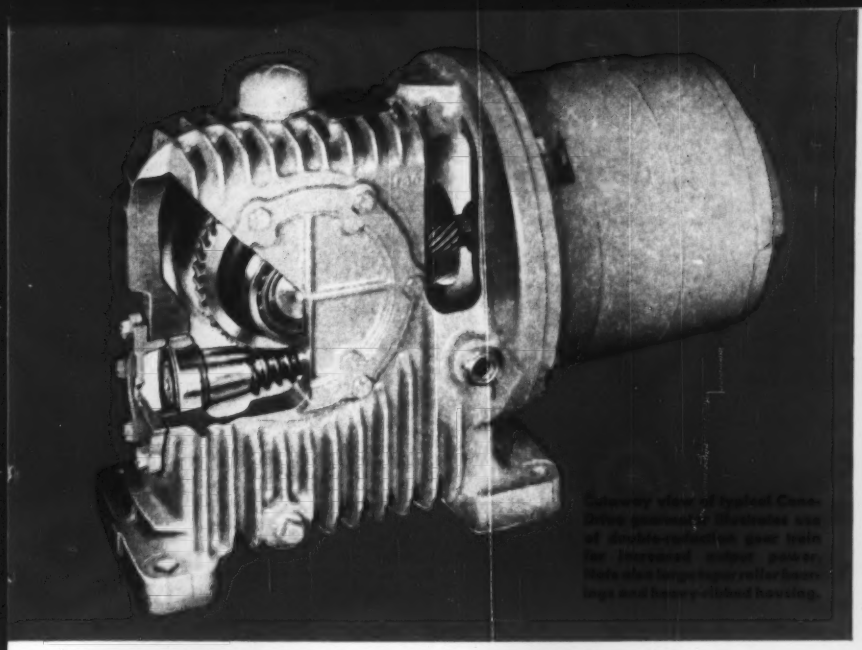

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Reznor Mfg. Co.
Rhoque (Inc.)
Ronald Press Co.
Ross Heat Exchanger
Div. American-Standard

Sheffield Corp.
Snap-Tite (Inc.)
Spraying Systems Co.
Stewart-Warner Corp.
Alemite Div.
Stillwater Clay Products Co.
Streeter-Amet Co.
Synchro-Start Products (Inc.)

*Taylor Forge & Pipe Works
*Taylor Instrument Cos.
*Tube Turns
*Tube Turns Plastics (Inc.)

*U. S. Hoffman Machinery Corp.
United States Pipe & Foundry Co.
Universal Drafting Machine Corp.

Van Der Horst Corp. of America
Van Nostrand, D., Co.
Vickers (Inc.)
Div. Sperry Rand Corp.
*Voss, J. H. H., Co.

Watson, H. S., Co.
Wheeler, C. H., Mfg. Co.
Wickes Boiler Co.
Div. Wickes Corp.
Wiedeke, Gustav., Co.
Wiegand, Edwin L., Co.
Wiley, John & Sons
Winzeler Mfg. & Tool Co.
Wisconsin Motor Corp.

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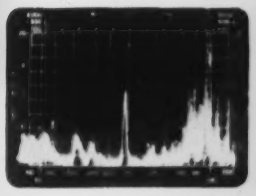
Fairchild Engineers use Panoramic LP-1a, for rapid, reliable vibration analysis.

This is Panoramic's Sonic Analyzer Model LP-1a, an automatic vibration analyzer used by development engineers at Stratos Division—Fairchild Engine & Airplane Corp. to measure vibrations of airborne air conditioning packs.



10-second screen photo of accelerometer output waveform as shown on the LP-1a's broad-band 40-20,000 cps logarithmic scale, linear amplitude (Courtesy of Fairchild Engine & Airplane Corp., Strato Div.)

The direct reading spectrographic displays of vibration frequency components on the screen of the LP-1a are found to be a valuable aid in rapidly evaluating the dynamic performance characteristics of prototype units. The spectral distribution of the vibrations, sensed with a barium titanate accelerometer, facilitates monitoring specific elements of the pack such as bearings, impeller blades etc. because of the different motional frequencies associated with each. Relative "g" levels are shown by the amplitudes of the frequency components. The magnitude of vibration at the rotational rate is a reliable guide to the dynamic balance of the rotor.

The Fairchild air conditioning packs are tested at speeds up to 100,000 revolutions per minute thus precluding direct monitoring on the shaft. The pick-up is placed on the housing during test runs. The accompanying figure is illustrative of a broad-band, 40–20,000 cps logarithmic spectrum analysis of the accelerometer output waveform. For more detailed study of interesting regions of the band, the LP-1a features of narrow-band linear sweepwidths of ± 100 cps, ± 500 cps and ± 2500 cps are employed with any center frequency, from 0–20 kc.

Because of the LP-1a's simple operation and direct reading screen, non-professional personnel were trained in its use at the Stratos Division. They made Polaroid photographs of the screen displays thus freeing valuable engineering manpower.

Accessory equipment available with the LP-1a permits photographs or pen and ink recordings of waveform content to be made for detailed analysis and studies over extended periods of time. Other accessories aid in comparison of similar devices by alternating their spectrum analyses on successive scans.

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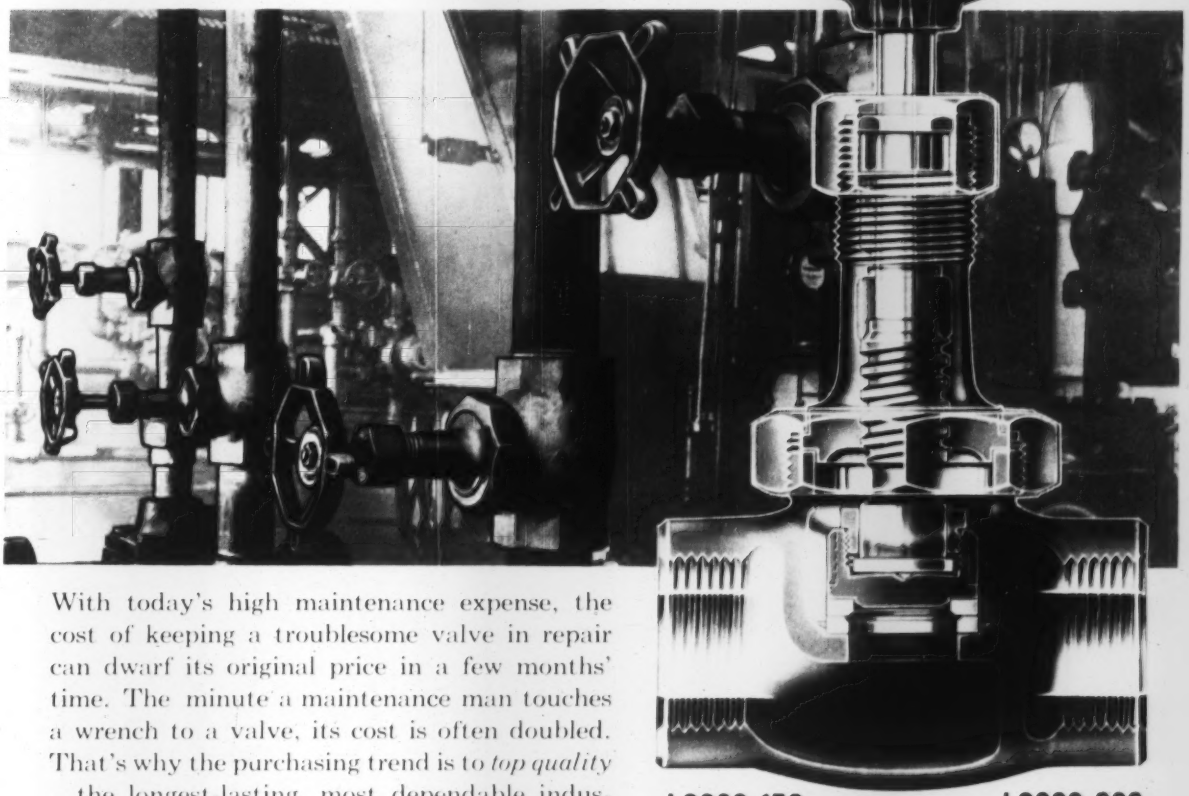

With today's high maintenance expense, the cost of keeping a troublesome valve in repair can dwarf its original price in a few months' time. The minute a maintenance man touches a wrench to a valve, its cost is often doubled. That's why the purchasing trend is to *top quality* the longest-lasting, most dependable industrial equipment on the market. And in the valve field, that means Lunkenheimer . . . famous for quality and maintenance-free service since 1862. The Lunkenheimer Company, Box 360 Annex Station, Cincinnati 14, Ohio.

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